

SECTION I

TECHNICAL SPECIFICATIONS

GENERAL PROVISIONS

1.1. SCOPE

These Technical Specification sets forth several items of work or conditions, which are required as integral parts of the successful completion of the Project. All items discussed herein are considered incidental to overall accomplishment of the Project and no separate payment shall be made therefore. In the Technical Specifications each section defines scope of work and certain aspects of that work. Any work discussed in these Technical Specifications not listed as a Bid Item or on the Bid Item Description shall be considered incidental to the Technical Specifications unless otherwise directed by the Engineer.

1.2. CONTRACTOR'S FACILITIES

The CONTRACTOR shall provide all temporary facilities for the proper completion of the work, as necessary and as specified.

1.2.1. Sanitary Facilities: The CONTRACTOR shall provide and maintain a portable toilet and all other necessary sanitary facilities at the site, in accordance with all applicable regulations, and shall properly remove same at completion of the Project.

1.2.2. Utilities: The obtaining of all utilities, which may be required for the construction shall be the responsibility of the CONTRACTOR.

1.2.3. Field Office: On all jobs where the construction period is set at **180 days** or more a field office will be required. The field office shall have electricity and a large enough area where the Drawings can be reviewed and meetings held during inclement weather.

1.3. UTILITIES

It shall be the CONTRACTOR'S responsibility to locate all utilities, make appropriate arrangements regarding relocation, either temporary or permanent, maintain the utility service throughout the construction period, and make final relocations at the completion of the work. Such work is to be performed under the direction of the ENGINEER and to the satisfaction of the owner(s) of any utilities encountered. The CONTRACTOR shall be solely responsible for protecting all utilities on the project site and for making any necessary relocation. All such relocations are to be presented to and approved by the ENGINEER prior to undertaking such work.

A concerted effort must be made to prevent any disruption of service; in the event such disruption occurs, the CONTRACTOR must immediately correct same.

1.4. **STAKING AND MARKING**

1.4.1. **General:** Prior to the beginning of construction, the ENGINEER will stake the plan baselines and provide the CONTRACTOR with information regarding reference points for reestablishment of lines and bench marks as necessary; and will mark the construction limits. It is the CONTRACTOR'S responsibility to maintain all lines, points, and bench marks in an undisturbed state. The CONTRACTOR shall use the baseline and cross-sections shown on the plans for all volume estimates presented to the ENGINEER. No consideration will be given to any quantities derived from other baselines or cross-section configuration. Truck counts shall not be used as a method to measure volumes but may be used for estimating purposes.

1.4.2. **Grade Staking:** Grade staking shall be the responsibility of the CONTRACTOR. Grade staking includes staking of all earthwork areas prior to and during performance of the required work. Staking is to be performed as necessary to assure the lines and grades specified on the Drawings are achieved. As a minimum, staking is to be updated monthly as the work progresses. The ENGINEER may direct more frequent updating as may be necessary to keep lines, grades, cut and fill designations current throughout construction. The CONTRACTOR shall be required to stake design grade lines a maximum of 100 feet apart.

Construction staking as specified is required to adequately delineate earthwork areas (both excavation and embankment); to provide horizontal and vertical control necessary to monitor the progress of the work, and to accurately define the alignment of appurtenances; to maintain plan baselines; to permit field adjustments where necessary; and to facilitate timely verification of progress estimates.

1.4.3. **Pre Excavation and Backfilling Requirements:**

Prior to any excavation or backfilling efforts, the CONTRACTOR shall be required to contact Kentucky Underground Protection Inc. (KUP) (ph. 1-800-752-6007) to obtain information concerning potential underground utilities within the project limit(s). All utilities that may be discovered by KUP shall be marked in the field AND disclosed to the ENGINEER. **No excavation or backfilling work of any type shall begin until the ENGINEER has given approval.**

1.4.4. **Cross-Sectioning:** The ENGINEER shall be responsible for cross-sectioning earthwork areas to determine "Actual Quantities", if required. Volumes shall be determined by before and after cross-

sections conducted by Division of Abandoned Mine Lands personnel or their representatives. Initial sections will be taken following site preparation and before earthwork is started.

1.4.5. **Payment**: Construction staking is considered incidental and, as noted in subsection 1.1, no separate payment will be made.

1.4. **TESTING**

During the construction process there are certain sections of these Technical Specifications that require testing to insure that the Technical specifications are being adhered to. The Inspector, Contractor and Engineer shall be familiar with those tests as required and insure they are done in accordance with these Technical Specifications. The Engineer at any time may require that additional tests be done to insure that the Technical Specifications are adhered to.

When the Technical Specifications refer to Kentucky Transportation Cabinet's (KYTC) Standard Specifications for Road and Bridge Construction it shall mean the most recent edition published by the KYTC either in paper form or on their webpage.

1.5.1. **Codes and Standards**: Testing, when required, will be in accordance with all pertinent codes and regulations and with selected standards of the American Society for Testing and Materials (ASTM) and the Kentucky Transportation Cabinet's Kentucky Methods. All testing shall be done by certified personnel.

1.5.2. **Payment for Testing Services**

1.5.2.1. **Initial Services**: The COMMONWEALTH will **either pay or provide for** all initial testing services which are required by the ENGINEER.

1.5.2.2. **Retesting Services**: When initial tests indicate non-compliance with the required specifications, all subsequent retesting made necessary by the non-compliance shall be paid by the CONTRACTOR.

1.5.2.3. **Contractor's Convenience Testing**: Inspection of testing performed exclusively for the CONTRACTOR'S convenience shall be the sole responsibility of the CONTRACTOR.

1.5.2.4. **Cooperation with the Testing Laboratory**: Representatives of the testing laboratory shall have ready access to the work at all times. The CONTRACTOR shall provide facilities for such access in order that the laboratory may properly perform its functions.

1.6. **INSTALLATION REQUIREMENTS**: Manufactured articles, materials and equipment shall be applied, installed, connected, erected,

used, cleaned, and conditioned as suggested by the respective manufacturers, unless otherwise specified herein or directed by the ENGINEER.

1.7. **PROOF OF COMPLIANCE:** Whenever the Contract Documents require that a product be in accordance with Federal Specifications, ASTM designations, ANSI specifications, or other association standards, the CONTRACTOR shall present a certification from the manufacturer that the product complies therewith. When specified, the CONTRACTOR shall submit supporting test data to substantiate compliance. All Certifications shall be maintained at the job site by the inspector and should be available upon request. Once the job is complete all certifications shall be place in the project file. Materials required to have proper certification(s) shall not be paid for until the proper certifications are produced.

1.8. **SUBSURFACE INFORMATION**

Site-specific geotechnical information is limited. Without regard to the materials encountered, all excavation shall be unclassified. It shall be distinctly understood that any reference to rock, soil, or any other material in the Drawings or in the Technical Specifications, whether in numbers, words, letters, or lines, is solely the COMMONWEALTH'S information and is not to be taken as an indication of classified excavation or the quantity of rock, soil, or any other material involved.

1.9. **MAINTAINING STREAM FLOW**

The CONTRACTOR shall obtain approval from the ENGINEER for temporarily blocking the flow of any stream within the project limits, if required. Consideration of downstream property owners must be made prior to blocking or releasing flow of the stream.

Should any existing culverts become inoperable or damaged because of work required under this Contract, the CONTRACTOR will immediately restore it to an operable condition. Existing culverts designated for cleaning shall be accomplished without any additional interference to flow at locations shown on the Drawings and with the approval of the ENGINEER.

Maintenance of stream flow shall be considered incidental to the overall accomplishment of the project.

1.10. **DUST CONTROL**

The CONTRACTOR shall be responsible for minimizing the generation of dust outside of the project limits. The CONTRACTOR shall be required to maintain all excavations, embankments, stockpiles, haul roads, permanent access roads, plant sites, waste areas, and all other work areas within or without the project boundaries free from dust, which would cause a hazard or nuisance to others. Approved temporary methods of stabilization consisting of sprinkling,

chemical treatment, light bituminous treatment or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

1.11. **SEDIMENT CONTROL**

The CONTRACTOR will be responsible for control of siltation and erosion from the project within the construction limits of the project site. Control shall include all necessary measures to minimize the deposition of materials in downstream areas. The CONTRACTOR shall attempt to schedule construction activities so that the amount of exposed soil is minimized. This is to be accomplished by disturbing only those areas, which are to be worked immediately, and by revegetating each area as soon as practical. In addition, all silt control measures, as shown on the Drawings or as added by the ENGINEER, must be installed prior to construction activities in accordance with these Technical Specifications.

1.12. **ACCESS**

1.12.1. **State/Federally Maintained Roadways:** Damage to state and/or federally maintained roadways caused by accessing the job site shall be repaired by the CONTRACTOR unless work (i.e., culvert installation, roadway ditch, etc.) has been designated on the Drawings. The CONTRACTOR shall be responsible for adhering to all state and federal regulations that govern the roadway(s) he travels to access the job site.

1.12.2. **Public and/or Private Roadways:** Damage to public and/or private roadways caused by the CONTRACTOR during the contract period, and in order to mobilize equipment and supply materials to the site, shall be paid for under the Contract Documents. Use of a public and/or private route and/or roadway shall be submitted to the ENGINEER for approval.

1.12.3. **Haul Roads:** The CONTRACTOR, when required to use existing haul roads, shall upgrade the road to allow for proper surface drainage and a suitable roadway base as necessary to accommodate the required construction during all weather conditions. Upgrading of the haul road shall be paid for under the Contract Documents. A plan to upgrade haul roads, unless already provided for in the plans, shall be submitted to the ENGINEER for approval.

1.12.4. **On-Site Construction Roads:** Roads constructed between work areas and/or waste areas for the convenience of the CONTRACTOR to accomplish the reclamation, as shown on the Drawings, shall be reclaimed following use to a stable, free draining configuration and revegetated in accordance with these Technical Specifications and appropriate barricades placed across said road to prevent ingress to the areas, at no expense to the COMMONWEALTH.

1.13. **TEMPORARY SHUTDOWNS**

The COMMONWEALTH desires to complete the project in the most timely manner possible. However, in the event an extended construction "shutdown" is requested by the CONTRACTOR, due to circumstances beyond the CONTRACTOR'S control, the CONTRACTOR will be required to dress all disturbed areas to a reasonable smooth configuration, as approved by the ENGINEER, protect the areas in accordance with the provisions of "Revegetation" section of the Technical Specifications, and maintain sediment control structures during this period. Such work shall include the applications of mulch and/or netting, as directed by the ENGINEER. The COMMONWEALTH shall incur no additional costs for such work, nor for the expense of demobilization or remobilization.

1.14. **CLEAN UP**

After all construction work is complete and prior to final inspection, all exposed areas shall be cleaned and left in a slightly condition. All unused materials, including but not limited to, channel lining larger than 6" and tree limbs and roots larger than 2" in diameter shall be removed and disposed of properly. Any disturbed areas shall be seeded in accordance with the applicable specification. The cleanup shall also include the removal of any trash and debris currently deposited within the project work limits or deposited during the contract period. The trash and debris shall be transported to an approved landfill in accordance with the Technical Specifications.

1.15. **REPAIR OF DAMAGE**

Any damage done to structures, fills, roadways, or other areas shall be repaired at the CONTRACTOR'S expense before final payment is made. In the event such damage occurs as a result of instructions from the ENGINEER, payment will be made at the bid unit price for such item or in a lump sum as agreed to by both parties.

1.16. **PROJECT EXTENT**

The CONTRACTOR shall be responsible for satisfying himself as to the construction limits for the Project. The CONTRACTOR shall not establish work, storage, or staging areas outside the project limits, unless otherwise directed or approved by the ENGINEER.

1.17. **WORKING HOURS**

Working hours on this project shall be from 8:00 a.m. to 4:30 p.m., Monday through Friday, for the duration of the construction

project. Critical work items, as determined in writing by the ENGINEER, will be scheduled for work during these times. The ENGINEER may approve Critical Work, at his sole discretion, at other times when the performance of such work is in the best interest of the Commonwealth. Emergency work, such as necessary pumping, fire quenching, smoke/fume control, or utility repair shall be completed as required, but the CONTRACTOR shall provide the ENGINEER as much notice as is practicable. Non-critical work, as determined by the ENGINEER, that does not require the ENGINEER (or his representative) to be on site may be completed between the hours of 7:00 a.m. - 7:00 p.m., Monday through Saturday, if requested by the CONTRACTOR and approved by the ENGINEER.

If the CONTRACTOR performs Critical Work outside working hours or without prior approval of the ENGINEER, the ENGINEER is under no obligation to accept or pay for such work.

1.18. **GUARANTEE:** The CONTRACTOR shall assume responsibility for all workmanship and materials for a period of one year from final payment. Any work found to be defective due to failure to comply with the provisions and intent of the Contract Documents shall be replaced at the CONTRACTOR'S expense.

1.19. **PROPERTY OWNER CONSIDERATION**

Authority to enter and reclaim private property is obtained by written consent of the owner and is pursuant to Title IV of the Surface Mining Control Act of 1977, 30 U.S.C. 1231, and KRS 350.150. The COMMONWEALTH, in complying with these provisions, does not obtain title or rights to any property within the project area. All rights to property and existing materials within the project area will therefore remain the property of the owner.

Materials having a salvage value (coal, oil, gas, precious metals, timber, topsoil, etc.) shall remain the property of the owner. Salvageable material rejected by the owner shall become the responsibility of the CONTRACTOR to dispose of in a proper manner subject to the approval of the ENGINEER.

During the construction process it may happen that a property corner or property fence is disturbed as identified by the property owner(s). Every effort shall be made during the design phase to identify property corner or property fences. However, there are certain instances that they have not been identify either by AML or the property owner. If the property corners or property fences have to be disturbed due to construction they will be surveyed and referenced to be returned to their original spot. It shall be noted that once property corners or property fences are reset the Division of AML does not certify those as actual property corners or property fences. To determine actual boundary lines an actual survey conducted by a Licensed Land Surveyor in the Commonwealth of Kentucky will be required to establish property lines. The actual property owner(s) will be responsible for the establishment of said lines and not the Commonwealth.

1.20. **BURNING**

The Kentucky Division of Forestry reports that the leading cause of wildfires is unsafe debris burning. Therefore, open burning of any type of material will be accomplished in strict accordance with the following rules and precautions, and then only with the approval and under the direction of the ENGINEER.

The ENGINEER'S permission to burn and/or his presence at the site shall not be construed as relieving the CONTRACTOR of any responsibility in the event damage occurs or a citizen's complaint arises. The COMMONWEALTH accepts no responsibility for damage or costs associated with burning operations.

1.20.1. **The "6:00 Burning Law":** KRS 149.400 established February 15 through April 30 and October 1 through December 15 as the FIRE HAZARD SEASON. During these fire seasons, everyone is prohibited from burning anything capable of spreading fire within one-hundred-and-fifty (150) feet of any woodland or brushland, except between the hours of 6:00 p.m. and 6:00 a.m., prevailing local time, or when the ground is covered with snow.

1.20.2. **Additional Forest Protection Laws:** The provisions of KRS 149.370 are of particular importance on abandoned mine land reclamation sites. Briefly, chief provisions require:

- (1) that the consent of the owner of the land on which burning is to be performed be obtained beforehand;
- (2) that adjacent landowners be notified beforehand; and
- (3) that "reasonable precautions" be taken to prevent the escape of fire to adjoining lands.

1.20.3. **Precautions:** The Kentucky Division of Forestry has provided the following list of precautions to help reduce the potential of forest fires:

- (1) If burning must be performed, WAIT UNTIL AFTER 6:00 P.M. - or even later if the weather has been dry and/or windy.
- (2) Burn only WHEN THE WINDS ARE CALM and there is no chance of gusts.
- (3) Burn ONLY ON LEVEL GROUND. On slopes and in gullies, a fire can escape more easily and make a fast run uphill.
- (4) When burning trash, use a barrel or deep pit

with a screen over top.

- (5) CLEAR THE AREA ten feet around where the fire will be. This creates a fire break. If possible, also plow around the area where the fire will be.
- (6) Make sure THE AREA OVERHEAD IS CLEAR of material that could burn.
- (7) HAVE TOOLS HANDY: a water hose, buckets of water, rakes, hoes, shovels, wet sacks, etc. These can be used to keep the flames inside the cleared area, subdue the flames if the wind picks up or the fire grows too big, smother the fire, or put a control line around it if it is getting out of hand. (More sophisticated equipment may be required by the ENGINEER.)
- (8) Have more than one person to watch the fire. Be sure THE FIRE IS ATTENDED at all times by responsible people.
- (9) Watch for SPOT FIRES. Cinders and sparks can carry through the air and start a "spot" of fire off in the distance.
- (10) FEED THE FIRE SLOWLY. Do not burn everything all at once. This will control the level of burning and intensity of the fire.
- (11) Stay with the fire UNTIL THE LAST SPARK IS DEAD OUT. Carefully reinspect the burned area the next morning.
- (12) If your fire escapes out of control, IMMEDIATELY REPORT IT to the Kentucky Division of Forestry's local guard or ranger. The local fire department, county dispatcher, or state police may also help if you want to report a forest fire.

1.20.4. **Contractor's Responsibilities:** The CONTRACTOR must:

- (1) Assure that all persons in his employ, including SUBCONTRACTORS and their employees, are knowledgeable of all provisions of KRS 149;
- (2) Provide the ENGINEER with all particulars regarding proposed burning generally one full workday in advance;
- (3) Comply fully with the letter and intent of the precautions established, and all other reasonable precautions, as if the term "the CONTRACTOR must" is implied;
- (4) Accept responsibility for the actions of his personnel; and

- (5) Comply with all instructions of the ENGINEER regarding safe and legal burning techniques.

1.20.5. **Disposal:** The CONTRACTOR shall dispose of ash, and unburned or partially burned debris in a neat and safe fashion, as approved by the ENGINEER.

1.20.6. **Restrictions:** No burning will be permitted in or adjacent to areas where coarse or fine coal refuse materials are encountered.

1.21. **PERMITS**

The CONTRACTOR shall obtain all applicable permits from state and federal agencies unless otherwise directed by the ENGINEER. **All permits or copies of permits obtained for the specified project shall be maintained at the site by both the Inspector and Contractor and be available upon request.**

1.22. **BLASTING RESTRICTIONS**

It is the intent of the Project to accomplish the required work without the aid of blasting. Therefore, no blasting will be permitted, unless the CONTRACTOR has exhausted all appropriate alternatives to accomplish the required work. Once the CONTRACTOR has reached a decision to use blasting in the accomplishment of the work, he shall prepare written documentation outlining the blasting plan and requesting approval from the ENGINEER at least two (2) weeks in advance of such work. The ENGINEER (both the project engineer and the Division of Abandoned Mine Lands) will review the request and either approve or deny the request in written form. If blasting is permitted, it shall comply with all applicable state (KRS Chapter 351, 805 KAR 4:010 through 4:150) and federal laws and the Earthwork Section of these Technical Specifications.

1.23. **COAL REMOVAL**

No coal, refuse, or other mineral resources shall be removed neither from the project area nor from the construction areas in conjunction with this contract.

SECTION II

TECHNICAL SPECIFICATIONS

MOBILIZATION

2.1. SCOPE

This element of work shall consist of the mobilization of the CONTRACTOR'S forces and equipment necessary for performing the work required under the contract.

It shall include the purchase of contract bonds; transportation of personnel, equipment, and operating supplies to the site; establishment of offices, buildings, and other necessary facilities at the site; and other preparatory work at the site. This specification covers mobilization for work required by the contract at the time of the award.

2.2. GENERAL

The amount, which a CONTRACTOR may bid for this item, shall not exceed five percent (5%) of the sum of the total bid for all other items, and shall reflect the CONTRACTOR'S cost for final demobilization in addition to his initial mobilization. Any bids in excess of this amount shall be automatically adjusted down to five percent (5%) and computations and award, when made, shall be based on the adjusted amount.

2.3. PAYMENT

Reimbursement for "Mobilization" shall be divided into two (2) incremental payments per project / site-- approximately equal to seventy-five percent (75%) and twenty-five percent (25%), respectively of the **approximate percentage value of work to be done at each project or site based on the Summary of Quantities breakdown.**

The first payment (per project or site) shall be made only after sufficient personnel, materials, equipment, and facilities have been mobilized to each particular project/site to demonstrate the CONTRACTOR'S intent to undertake the bulk of the work. And not until the field office (if required), related facilities and utilities are in place as may be required under Subsection 1.2 of Section I of these Technical Specifications.

The second payment (per project or site), i.e., the remaining twenty-five percent (25%), shall be made after the CONTRACTOR has completed an amount of work equal to ten percent (10%) of the total for remaining bid items as based on percentage value for each project/site, and only after an acceptable schedule, as required under Article C of the Contractual Obligations & Requirements, has been received for each site.

Payment will not be made under this item for the purchase costs of materials having a residual value, the purchase costs of materials to be incorporated in the project, or the purchase costs of operating supplies.

Payment of the total lump sum price for "Mobilization" as entered on the bid schedule shall constitute full compensation for all labor, materials, equipment, and all other items necessary for and incidental to completion of this element of work. Moreover, this payment amount shall be considered total payment for all mobilization (and demobilization) efforts for all projects, which include all designated projects / sites and shall never exceed under any circumstance, the stated amount entered on bid schedule(s).

2.4. **ADJUSTMENTS**

This specification covers mobilization for work required by the contract at the time of award. If additional mobilization costs are incurred during performance of the Contract as a result of changed or added items of work for which the CONTRACTOR is entitled to an adjustment in contract price, compensation for such costs shall be included in the price adjustment for the items of work changed or added.

SECTION III
TECHNICAL SPECIFICATIONS
SILT CONTROL

3.1. **SCOPE**

This work shall consist of furnishing all materials, equipment, labor, and incidentals necessary for the installation of silt control facilities depicted in the Drawings and as directed by the ENGINEER.

3.2. **GENERAL**

The ENGINEER shall direct the exact locations, configuration, and dimensions of the various types of silt control at the time of construction. These structures shall be installed prior to any surface disturbance for which they are necessary to control silt. As erodible areas are exposed, construct temporary drainage ways where needed to divert runoff from erosive soils areas to the silt traps.

The CONTRACTOR shall schedule construction activities so that the amount of exposed soil is minimized. This is to be accomplished by disturbing only those areas, which are to be worked immediately, and by revegetating each area as soon as practical.

3.3. **MATERIALS**

3.3.1. **Silt Control Bales:** Either straw or hay bales, firmly bound by twine, and installed using wooden stakes as shown in the Drawings

3.3.2. **Geotextile Fabric Silt Fence:** Conform to AASHTO M 288 for temporary silt fence. Provide fabric with a height of 3 feet.

3.3.3. **Wooden Stakes:** Hardwood, greater than 4 feet long, minimum of 1 ½" by 1 ½" with cross sections straight enough to provide a fence without noticeable misalignment.

3.3.4. **Fasteners:** Use No. 9, one-inch long, wire staples, and/or fabric ties.

3.3.5. **Gabions:** Gabion silt structures shall meet the requirements as set forth in the Gabion Section of These Technical Specifications.

3.3.6. **Stone:** Stone silt checks shall meet the requirements of the Crushed Aggregate Section and Channel Lining Section of these Technical Specifications.

3.4. **INSTALLATION**

3.4.1. **Silt Control Bales:** Place bales with **1/2 foot** overlap and two stakes per bale.

3.4.2. **Temporary Silt Fence:** Construct continuous and traverse to the flow. **Silt fence shall be installed per manufacture's instructions or as shown on the Drawings.** Limit the equivalent runoff area to 1,000 square feet per 10 feet of temporary silt fence.

3.4.3. **Silt Trap - Type A:** Construct excavated pits from 2-3 feet in depth, 20-30 feet in length, and 5-10 feet in width. Transport excavated materials to waste area or area designated by ENGINEER.

3.4.4. **Gabion Silt Structure:** All gabion silt structures shall be installed at locations shown on the Drawings or as directed by the Engineer. Gabions shall be installed in accordance with the Gabion Section of these Technical Specifications.

3.4.5. **Stone Silt Structures:** Stone silt structures shall be installed at the locations shown on the Drawings or as directed by the Engineer.

3.5. **MAINTENANCE**

Inspect all erosion control devices weekly and after each 0.1-inch rainfall event. Remove all accumulated silt when the devices are 50 percent full and place in approved waste area or as directed by ENGINEER.

Upon completion of the project, the ENGINEER may direct the CONTRACTOR to remove, clean, or replace silt control structures and revegetate such disturbances in accordance with the "Revegetation" section of these Technical Specifications. Silt control fence (geofabrics) shall be removed and disposed of properly at the end of construction activities.

SECTION IV
TECHNICAL SPECIFICATIONS
SITE PREPARATION

4.1. **SCOPE**

The work shall consist of the clearing, grubbing, and/or stripping of all construction areas as shown on the Drawings, and removing and disposing of any trash and debris within the project limits. In addition, pipe removal and disposal shall be considered part of Site Preparation.

4.2. **CLEARING AND GRUBBING**

4.2.1. **General:** All trees, snags, logs, stumps, shrubs, rubbish, and garbage shall be removed from the cut and fill areas shown on the Drawings or as directed by the ENGINEER.

Unless otherwise specified or directed, all stumps, roots, and root clusters having a diameter of 1 inch or larger shall be grubbed out to a depth of at least 1-foot below ground surface in all designated areas.

4.2.2. **Disposal:** All trees cleared from the construction areas, including the waste areas, are properties of the surface owners. The CONTRACTOR shall be responsible for transporting to and storing trees on individual surface owner's property at locations designated by each owner.

All remaining cleared and grubbed material shall be disposed of in a manner acceptable to the ENGINEER and in a manner not detrimental to the project or the inhabitants of the area. The CONTRACTOR will be responsible for determining and complying with local ordinances, regarding disposal, and/or burning of such materials.

4.3. **STRIPPING**

4.3.1. **General:** Areas on which excavation or fill operations are to be performed shall be stripped of all vegetation, topsoil, and other organic material as directed by the ENGINEER.

4.3.2. **Disposition of Stripped Materials:** Stripped soil material shall be utilized or disposed of in a manner directed by the ENGINEER. Stockpiling of topsoil-type material will be required.

4.4. **MISCELLANEOUS SITE PREPARATION WORK**

4.4.1. **DEBRIS REMOVAL AND DISPOSAL**

The work shall consist of the removal of domestic household trash & mining debris from the project area (i.e. construction limits, project limits, work limits, etc.) and its transportation to, and appropriate placement, in a permitted landfill. The CONTRACTOR shall advise the ENGINEER of the landfill to be used and shall obtain the ENGINEER'S approval prior to the hauling of trash and mining debris. All debris shall be transported in a safe manner, being covered or otherwise secured as necessary to prevent loss in transit.

4.4.2. **PIPE REMOVAL AND DISPOSAL**

The work shall consist of the removal of pipes and culverts (if instructed on Drawings or by the ENGINEER) from the project area and its transportation to, and appropriate placement, in a permitted landfill. The CONTRACTOR shall advise the ENGINEER of the landfill to be used and shall obtain the ENGINEER'S approval prior to the hauling of trash and mining debris. All debris shall be transported in a safe manner, being covered or otherwise secured as necessary to prevent loss in transit.

SECTION V

TECHNICAL SPECIFICATIONS

EARTHWORK

5.1. SCOPE

The work shall consist of the required removal and proper utilization of all earthen materials and the shaping and finishing the area(s) to the required lines and grades as shown on the Drawings or as directed by the ENGINEER.

5.2. MATERIALS

5.2.1. **Excavated Materials:** All excavated materials shall be unclassified. It is anticipated that the majority of the material to be removed will consist of a mixture of loose, unconsolidated soil, vegetative debris and rock. It may also consist of residual soil and "mine spoil" produced from past mining operations. Also, large boulders may exist within the excavation areas.

5.2.2. **Refuse:** Refuse in these Technical Specifications is defined as coal, coal waste, rock and other debris that was produced and discarded by past mining practices. Some areas will have a higher content of coal than others depending on the mining method. Generally the material is sparsely vegetated and very acidic. Some areas may be burning or have burned in the past.

5.2.3. **Rock:** Rock in these Technical Specifications is defined as that material that cannot be removed by normal excavation methods and must be removed by the means such as blasting, ripping, hoe ram or other methods used in the construction industry that are generally accepted as methods to remove rock.

5.2.4. **Cover Material:** Acceptable cover materials should have a brown matrix color, soil water pH greater than 4.5, potential acidity of less than 2 tons calcium carbonate equivalent per thousand (1000) tons of material, and less than 50% clay content.

5.2.5. **Lime:** In some cases a lime barrier may be specified on the Drawings, before soil(earth cover) is placed to its final grade. Lime used in this manner shall meet the requirements of the Revegetation Section of these Technical Specifications.

5.3. GENERAL

5.3.1. **Material Removal:** Material removal shall include excavation to the designated depths, transportation of removed materials from points of removal to the points of final use and the shaping and finishing of all areas to the required lines and grades as shown on the Drawings or as directed by the Engineer. All boulders

encountered during the construction, which are too large to be transported to the waste area may be moved to the stable area within the project limits and buried on site with a minimum of two (2) feet cover or they may be reduced to a size that can be transported to the waste area or other areas designated on the Drawings or as directed by the Engineer. The boulders may be reduced by the use of hoe-ram as specified by these Technical Specifications or other methods approved by the Engineer.

5.3.2. **Waste Areas:** The materials to be placed in designated fill areas shall consist of those suitable materials, as determined by the ENGINEER, which are removed in the process of achieving the templates shown on the Drawings and in accordance with this section of these Technical Specifications. Vegetative debris shall not be placed in the designated waste areas. It shall be the CONTRACTOR'S responsibility to dispose of unsuitable materials in accordance with the provisions of the Specification.

The ENGINEER shall inspect and approve the disposal sites before material is placed in a given area. Any boulders, which are transported to a waste area shall be buried a minimum of two feet under the final grade or reduced to a size that will not affect the fill operation. On all waste areas excavated topsoil and/or select material shall be uniformly distributed as a final cover material. The waste area(s) shall be revegetated in accordance with the Revegetation Section of these Technical Specifications.

Old strip mine benches to be used as waste areas must be sampled every 50' feet to determine the presence of rock under the material that now exists. Once the rockline has been established and the edge of rock determined, the contractor upon approval from the Engineer shall begin placement of material on the bench. Material placed on the bench shall be at least 10' from the edge of the rockline determined by the field sampling and approved by the Engineer.

5.3.3. **Cover Material Harvesting Areas:** In the Cover Material Harvesting areas (borrow areas), all limits are to be approved by the ENGINEER prior to any work efforts (site prep, silt control, earthwork, etc.) commencing. Once excavation work is completed within a designated harvesting area, it shall be graded as directed by the ENGINEER. No areas shall have final slopes steeper than a 2.5: 1 nor shall trenches and/or pits be left as a final grade. All disturbed areas shall be revegetated as soon as practical in accordance with the revegetation specifications.

5.3.4. **Gradework Areas:** Grade areas to the lines and grades indicated on the Drawings or as directed by the ENGINEER to promote positive drainage.

5.3.5. **Sub-drain:** Sub-drain excavation for trenches exceeding depths of five feet shall include the removal of rock and/or unclassified soils to facilitate construction.

5.5. **CONSTRUCTION METHODS**

5.5.1. **Conduct of Work:** The reclamation approach intent is to provide a lasting, stable configuration. The CONTRACTOR is required to exercise care to avoid intermediate site conditions which may result in unstable conditions during the construction process.

5.5.2. **Excavation:** The CONTRACTOR must utilize material removal techniques that are generally considered conducive to retaining stability. This includes, but is not limited to, working slopes from the top to the bottom to preclude undermining. Once disturbed, all earthwork areas shall be brought to the design template as soon as practicable and shall be protected in accordance with the "Revegetation" section of these Technical Specifications as the work progresses.

The conditions set forth in this subsection shall firmly apply until the ENGINEER has accepted the area where material has been removed, as being satisfactorily complete. The ENGINEER will not accept any area as being satisfactorily complete if an adjacent work area remains in a condition, which may cause damage to the subject area. Once the ENGINEER has accepted an area, the COMMONWEALTH will then be responsible for interruptive slides, slippages, and/or erosion.

5.5.3. **Blasting**

5.5.3.1 **General:** Blasting when permitted shall be done only to the depth, amount and extent, and in such locations, as approved by the ENGINEER. Blasting operations shall comply with all applicable State and Federal laws. Neither the COMMONWEALTH nor the ENGINEER shall assume any liability through approval of the CONTRACTOR'S blasting plan or methods of blasting. Such approval will not relieve the CONTRACTOR of his responsibility in the blasting operation, and no payment will be made for any necessary extra excavation below or outside of the limit lines designated by the ENGINEER, or modifications thereof, due solely to injury caused by over-shooting, improper blasting, or carelessness on the part of the CONTRACTOR.

A licensed blaster licensed in the Commonwealth shall be on site at all times dealing with all blasting activities such as pre-blast survey, pre-blast preparation, actual blasting and post-blast activities.

5.5.3.2 **Pre-Blast Survey:** A pre-blast survey shall be conducted on all dwellings or structures located within 1/2 mile radius of any proposed blasting activity. The survey shall be the responsibility of the CONTRACTOR and shall consist of an assessment of the conditions of each dwelling or structure and documentation of any pre-blasting damage and other physical factors that could reasonably be affected by the blasting. Assessments of structures

such as pipes, cables, transmission lines, and other water systems shall be limited to surface condition and readily available data. Selected water wells shall be monitored for both quantity and quality during the initial survey and throughout the duration of blasting operations, at no additional cost to the COMMONWEALTH.

5.5.3.3. **Use of Explosives:**

- (1) The transportation, handling, storage, and use of dynamite and/or other explosives shall be directed and supervised by a person of proven experience and ability in blasting operations. All blasting operations shall be in accordance with applicable local, State, and Federal laws. Before any explosives are brought on the job, permission to do so shall be obtained from the ENGINEER.
- (2) All blasts shall be fired electrically with an electric blasting machine. Where detonating cord is used as a detonating agent, the detonating cord shall be fired with an electric blasting cap. Delay electric detonators shall be used for all delayed blasts. Blasting machines used for firing shall be known to be in good condition and of sufficient capacity to fire all charges. Rubber-covered or other adequately insulated copper wires in good condition shall be used for firing lines and shall have solid cores of appropriate size. Sufficient firing lines shall be provided to permit the blaster to be located at a safe distance from the blast. Single conductor lead lines shall be used.
- (3) All operations involving the handling or use of explosives shall be discontinued during approach of a thunderstorm or while it is in progress.
- (4) Radio transmitting shall not be allowed in the vicinity of any area where explosives are being used.
- (5) All holes loaded on a shift shall be fired on the same shift.
- (6) The use of black powder is prohibited.

5.5.4. **Sheeting and Bracing:** Sheeting and bracing as may be required to safely support the sides of excavations shall comply with the safety precautions as outlined in current and accepted safety manuals, such as "Associated General Contractors Manual of Accident Prevention in Construction". Where sheeting and bracing are necessary to prevent caving of the walls of excavation and to safeguard the workers, dig the excavations to such widths that proper allowance is made for the space occupied by the sheeting and bracing. The CONTRACTOR shall perform the additional excavation required, furnish and place the necessary sheeting and bracing, and remove same as the excavation is filled at his own expense.

5.5.5. **Material Placement:** No material shall be placed in any area until the area has been stripped as specified and the ENGINEER has approved the foundation. Foundation benches shall be excavated in all waste areas where the original ground slope beneath the fill is 15 percent or greater. The CONTRACTOR shall keep the area free from water or unacceptable material after the placement operations have started. Where depicted or described in the Drawings, an average depth of eighteen inches (18") of topsoil shall be stripped from the area and stockpiled at locations designated by the ENGINEER; the excavated topsoil shall be uniformly redistributed once all backfilling efforts have been completed.

When soil material is placed against sloping sides of excavations, slopes of old embankment, or natural slopes, the old material shall be cut or broken by machine or hand methods approved by the ENGINEER, until it shows the characteristic color of moist material. The equipment shall then compact both materials, bonding them together.

An agricultural limestone barrier may be required by the Drawings or ENGINEER in conjunction cover material to support revegetation efforts. Earthen cover placed over acidic materials such as refuse and slurry fines shall be a minimum of two (2) feet depth.

Earthen material shall be spread as follows:

- (1) The distribution throughout the area of fill shall be such that the fill will be free from voids, pockets, and bridging of material. The combined material removal and placement operations shall be such that the material, when compacted, will be blended sufficiently to ensure the best practicable degree of compaction and stability. Successive loads of materials shall be dumped to produce the best distribution.
- (2) No material placed in the fill area by dumping in piles or windrows shall be incorporated in a layer in that position, but shall be moved and spread by blading or similar approved methods. The thickness of layers placed before compaction shall be as designated in Section 5.5.7.
- (3) Material in the form of large soil lumps or soil masses shall be pulverized by disking, harrowing, or by the use of mechanical pulverizers prior to compacting.

The CONTRACTOR shall maintain and protect areas of fill in a satisfactory condition at all times until completion and acceptance of all work under the Contract. If, in the opinion of the ENGINEER, the hauling equipment causes horizontal shears of slicken sides, rutting, quaking, heaving, cracking, or excessive deformation of fills, the CONTRACTOR shall limit the type, load or travel speed of the hauling equipment on the areas of fill. During material placement, the CONTRACTOR shall remove from the areas of fill any material, which the ENGINEER considers objectionable, and shall also dispose of such material and refill the areas as directed, all at no additional cost to the COMMONWEALTH.

5.5.6. **Moisture Control:** During the compaction operation, the surface of the fill area and the materials being placed shall be maintained within the moisture content range required to permit proper compaction to the density specified herein. The moisture content shall be controlled in the following manner:

- (1) When material deposited on the fill is too dry, the CONTRACTOR shall be required to sprinkle each layer and obtain uniform moisture distribution in the layer by disking, blading, or other approved methods. The amount of water applied shall be accurately controlled so that free water will not appear on the surface during or subsequent to compaction operations.
- (2) Material deposited in fill areas that is too wet shall be removed or spread and permitted to dry, assisted by disking or blading if necessary, until the moisture content is reduced to the specified limits.
- (3) When the top surface of a layer becomes too dry or too smooth to permit suitable bond with the subsequent layer, the CONTRACTOR shall loosen the material by scarifying, disking, or using other suitable equipment in an approved manner until the in-place material shows the characteristic color of moist material to a sufficient depth to provide a satisfactory bonding surface as determined by the ENGINEER. The ENGINEER may also require that the loosened material be moistened, to acceptable moisture content as generally determined by visual inspection, and the material reworked, prior to compacting the material to the specified density.
- (4) Adjustments of moisture content shall be made based on determination of moisture by field tests as construction progresses.

5.5.7. **Special Handling:** Mixing, segregation, and/or other special handling of excavated materials may be required to avoid: concentrations of unsuitable materials in fill areas; development of lenses that may contribute to instability; and/or unacceptable voids, pockets, and bridging. Toward this objective, the CONTRACTOR may be required to excavate materials in a sequence which will, in the ENGINEER'S opinion, provide the best control for segregating extremely moist, weak, rocky, or other undesirable materials until same can be dried and/or otherwise properly incorporated into fill areas.

Materials consisting predominantly of non-friable rock, when placed in areas of fill shall not be dumped in final position, but shall be distributed in a manner that will ensure placement so that voids, pockets, bridging and settlement, or shifting are held to a minimum. Concentrations of predominantly rock materials, where the largest fragments do not exceed 1.5 cubic feet in size and the overall material sizes are generally in a well distributed range, may be placed in 2-foot (+) thick layers as approved by the ENGINEER. Larger rocks, particularly those approaching boulder

proportions, are to be isolated in the fill and material compacted around them as otherwise required herein. Rocks of sizes and/or gradations outside or between the ranges described are to be handled as directed by the ENGINEER on a case-specific basis.

5.5.8. **Compaction:** Compaction requirements for all AML projects will fall into one of three categories, Maximum Compactive Effort, Moderate Compactive Effort, or Minimum Compactive Effort. If the level of compactive effort is not designated elsewhere in the Specifications or on the Plans, then the fill area shall receive a Moderate Compactive Effort.

- (1) **Maximum Compactive Effort (Critical Use Areas):** Areas designated to receive maximum compactive effort shall have materials placed in 12 inch maximum horizontal lifts with an in-place moisture content within 3% of the optimum moisture content (ref. ASTM D-698). They shall be compacted with a minimum of 4 passes with a sheepsfoot roller with a foot contact area of 10 to 14 sq. ft. and foot contact pressure between 150 to 250 psi.. Should this method not provide sufficient compaction to achieve 95% of the materials maximum dry density with an in-place moisture content within 3% of the optimum moisture content (ref. ASTM D-698), then additional compactive effort and/or shallower lifts shall be required. In-place density and moisture tests shall be performed, utilizing methods outlined in ASTM D-2922, for every lift of material placed. The number of tests per lift shall be as determined by the ENGINEER. The ENGINEER shall be responsible for taking compaction tests.
- (2) **Moderate Compactive Effort (Non-Critical Use Areas):** Areas designated to receive moderate compactive effort shall have materials placed in 12-inch maximum horizontal lifts, spread, and compacted with successive passes of dozers or other tracked equipment. The satisfaction of the compaction/moisture control efforts shall be based on continuous assessments of the color, moistures, and overall suitability of materials slated for placement. The equipment to be used for spreading and compaction; as well as the reaction of the in-place materials to the applied loadings -- to ensure that pumping, weeping, heaving, and other conditions normally accompanying or indicating unacceptable compaction or moisture levels are not present. In the event of conflicts between the CONTRACTOR and ENGINEER, or persistence of placement/compaction problems, density and moisture testing will be initiated. Sufficient compaction shall be required to achieve 90% of the material's maximum dry density with in-place moisture content within 3% of the optimum moisture content and/or the ENGINEER may require a modification in the CONTRACTOR'S handling, placement, or compaction procedures.
- (3) **Minimum Compactive Effort (Non-Critical Use Area):** Areas designated to receive minimum compactive effort shall have materials placed in 24 inch maximum horizontal lifts and

spread and compacted with successive passes of dozers, track equipment, or rubber tired hauling equipment. Uniform compaction must be obtained throughout each lift. Moisture levels shall be monitored to ensure adequate compaction. If satisfactory compaction is not being achieved, then the ENGINEER may require the CONTRACTOR to meet compaction requirements established under moderate compactive effort.

Such testing, or the lack thereof, does not relieve the CONTRACTOR from ensuring that all lifts receive the appropriate amount of compactive effort. In-place material not meeting these specifications will be rejected and shall be removed and/or reworked until satisfactory results are obtained.

5.6. **CONSTRUCTION TOLERANCES**

Material removal shall include excavation to the designated depths, transportation of removed materials from points of removal to points of final use, and the shaping and finishing of all areas.

Material removal carried below the indicated depths, except when directed by the ENGINEER, shall be replaced with material satisfactory to the ENGINEER. Additional payment will not be made for unauthorized material removal nor for any backfilling necessitated thereby. All areas shall be constructed to the lines, grades, and cross-sections indicated on the Drawings, unless otherwise directed by the ENGINEER.

The CONTRACTOR shall make every reasonable effort to construct the project uniformly. Tolerances, which will be allowed, before changes will be made in the quantities to be paid or before reworking of the constructed item is required, are as follows:

- (1) The design intent is to stabilize the area(s) and to leave a free draining uniform surface suitable for revegetation. The nature of the Project does not lend itself very well to the establishment of numerical standards for permissible deviations from the templates and lines shown on the Drawings. A work area will generally be accepted when -- in the ENGINEER'S opinion -- the design intent has been achieved. However, in the event problems arise, the ENGINEER may require that the finished grades not deviate more than 1 foot (+) from the neat lines shown on the Drawings.
- (2) No payment will be made for any earthwork performed outside the limits shown on the Drawings or those approved by the ENGINEER. No extra material shall be removed or placed outside of these limits without permission.

SECTION VI

TECHNICAL SPECIFICATIONS

DITCHES

6.1. SCOPE

This item consists of the construction of ditches (and channels) to the lines and grades depicted in the final cross-sections and Drawings. Lining materials shall meet the requirements of related sections of these Technical Specifications. Excavated rock ditches shall be constructed in accordance with details included in the Drawings.

6.2. MATERIALS

6.2.1. Concrete: Conform to the Concrete Section of these Technical Specifications.

6.2.2. Erosion Control Blanket: Conform to the Erosion Control Blanket Section of these Technical Specifications.

6.2.3. Filter Fabric: Conform to the Filter Fabric Section **of these Technical Specifications.**

6.2.4. Rock Aggregate: Conform to the Crushed Aggregate and Channel Lining Section of these Technical Specifications.

6.2.5. Gabion: Conform to the Gabion section of these Technical Specifications.

6.2.6. Revegetation Materials: Conform to the Revegetation Section of these Technical Specifications, Revegetation of areas disturbed for ditch construction shall be considered incidental to Ditches.

6.2. CONFIGURATIONS

The configurations of the ditches shall approximate the configurations in the Drawings so that the design water flow will safely pass through the ditches. The ENGINEER must approve any significant deviation from the design dimensions.

6.4. CONSTRUCTION

6.4.1. Subgrade Preparation: The subgrade surfaces on which filter fabric, and/or rock are to be placed shall be graded to the lines and grades shown on the Drawings. Filter fabric shall not be placed until the foundation and the subgrade surfaces have been prepared, inspected, and approved by the ENGINEER.

6.4.2. **Rock Aggregate Placement:** Place and shape filter fabric in accordance with the filter fabric section under all ditches less than 10 percent slope or as **shown on** the Drawings or as directed by **the ENGINEER**. The channel lining shall be carefully placed by hand or by equipment to the depths specified on the Drawings. The lining shall be constructed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials and damage to the underlying filter fabric. The rock shall be delivered and placed in a manner that will ensure that the lining, in-place, shall be reasonably homogeneous -- with the larger rocks uniformly distributed and firmly in contact one to another, and with the smaller rocks and spalls filling the voids between the larger rocks.

Where encountering solid rock, end the slope protection at the solid rock line **as shown on the Drawings or as directed by the Engineer**

6.4.3. **Excavated Rock Ditches:** Excavated Rock Ditches shall be constructed at locations shown on the plans **or as directed** by the ENGINEER. Excavated Rock Ditches shall be considered incidental to Earthwork if natural swales in "excavated to rock areas" exist and no additional work is required. If extremely hard rock is encountered, then a hoe ram shall be utilized to construct the ditches. **The hoe ram shall have a minimum weight of 2000 lbs. and a minimum delivery capability of 300 rams per minute.** The CONTRACTOR may utilize alternative equipment with the approval of the ENGINEER.

6.4.4. **Gabion Lined Ditches:** Place and shape filter fabric in accordance with the filter fabric Section and construct gabion baskets in accordance with the Gabion Section of these Technical Specifications.

6.4.5. **Concrete Lined Ditches:** Place and shape filter fabric in accordance with the Filter Fabric Section of these Technical Specifications and construct forms as shown on the Drawings or as directed by the ENGINEER.

SECTION VII

TECHNICAL SPECIFICATIONS

EROSION CONTROL BLANKET

7.1. SCOPE

The work shall consist of placing erosion control blankets in ditches and on slopes as indicted on the Drawings or as directed by the ENGINEER.

7.2. MATERIALS

7.2.1. **General:** The erosion control blankets shall consist of a machine-produced blanket of natural organic fibers. The fiber thickness shall be consistent and evenly distributed over the entire area of the blanket.

7.2.2. **Erosion Control Blanket:** The erosion control blanket shall have both sides covered with extra heavy-duty plastic netting with a mesh opening of approximately 3/4-inch x 3/4-inch.

7.2.3. **Equivalency:** An acceptable erosion control product for the intended application is the SC-150 blanket, manufactured by North American Green. Equivalent products, from companies such as American Excelsior Company, and Xcel, are acceptable and shall be provided with certification from the manufacturer that the product will perform satisfactorily for maximum flow volumes and velocities as reported in manufacturer's literature for the North American Green SC-150 product.

7.2. CONSTRUCTION METHODS

After subgrade preparation, the area shall be seeded in accordance with the "Revegetation" section of the Technical Specifications before placement of the blanket.

The blankets shall be unrolled in the direction of water flow. When using two blankets side by side, the seams shall not be placed in the center of the ditch, but shall be offset by one (1) foot. Blankets shall be stapled in place by the use of "U" shaped staples of the size and at the prescribed intervals and arrangement specified by the manufacturers. When blankets are laid side by side, they shall be stapled to anchor the edge of each roll. Overlap of blankets shall be in accordance with the manufacturer's recommendations.

SECTION VIII

TECHNICAL SPECIFICATIONS

FILTER FABRIC

8.1. SCOPE

This work will consist of furnishing and placing filter fabric beneath ditches, around subsurface drains, and/or other applications as shown on the Drawings or as directed by the ENGINEER.

8.2. MATERIALS

The fabric shall meet the requirements of the following tables, depending on the intended application, and other criteria set forth in this Specification.

Table 8-1: **Fabric for Ditches and other Surface Features**

<u>PROPERTY</u>	<u>METHOD</u>	<u>REQUIREMENT</u>
Grab Tensile Strength	ASTM-D-1682	150 lb. (min.)
Tensile Elongation	ASTM-D-1682	20 pct (min.)
Trapezoid Tear Strength	ASTM-D-1177	65 lb. (min.)
Mullen Burst Strength	ASTM-D-751	275 lb. (min.)
Puncture Strength	ASTM-D-751	60 lb. (min.)
Water Permeability	AASHTO M288	0.008cm/sec. (min.)
Equivalent Opening Size	*CW-02215-77 (U.S. Standard Sieve)	20-40

Table 8-2: **Fabric for Subsurface Drains**

<u>PROPERTY</u>	<u>METHOD</u>	<u>REQUIREMENT</u>
Grab Tensile Strength	ASTM-D-1682	100 lb. (min.)
Tensile Elongation	ASTM-D-1682	20 pct
Trapezoid Tear Strength	ASTM-D-2263	55 lb. (min.)
Mullen Burst Strength	ASTM-D-3786	200 lb. (min.)
Puncture Strength	ASTM-D-751	50 lb. (min.)
Water Permeability	AASHTO M288	0.1 cm/sec. (min.)
Equivalent Opening Size (U.S. Standard Sieve)	*CW-02215-17	70-100

*Corps of Engineers' Test Procedure

Filter fabric shall be woven or non-woven, consisting only of long chain polymeric filaments or yarns such as polypropylene, polyethylene, polyester, polyamide, or polyvinylidene chloride formed into a stable network such that the filaments or yarns retain their relative position to each other. The fabric shall be inert to commonly encountered chemicals and free of defects or flaws, which significantly affect its physical and/or filtering properties.

The fabric shall be formed in widths of at least 6 feet. Sheets of fabric may be sewn together to form fabric widths as required. The sheets of fabric shall be sewn together at the point of manufacture or other approved locations.

During all periods of shipment and storage, the fabric shall be wrapped in a heavy-duty protective covering to protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140°F, mud, dirt, dust, and debris.

All fabric shall be approved before use. The CONTRACTOR shall furnish a Certificate of Compliance from the manufacturer with each shipment of fabric. The certificate, signed by an authorized official having legal authority to bind the company, shall attest that the fabric meets the specified chemical, physical, and manufacturing requirements. The certificate also shall include actual test results for each physical requirement of this specification. A sample of five (5) square yards shall be furnished with each shipment for verification testing.

8.3. **INSTALLATION**

The surface to receive filter fabric and aggregate shall be prepared to a relatively smooth condition free of obstructions, debris, or sharp objects that may puncture the fabric. The fabric shall be placed with the long dimension parallel to the flow line and shall be laid smooth and free of tension, stress, folds, wrinkles, or creases.

The filter fabric shall not be exposed to sunlight for a period of greater than two weeks. If the fabric is damaged during construction, placing a piece of fabric that is large enough to cover the damaged area and meet the overlap requirement shall repair the torn or punctured section.

8.3.1. **Laps:** When more than one strip is necessary, the strips shall overlap (longitudinally) a minimum of 24 inches. Transverse overlaps shall be a minimum of 18 inches and shall be placed so the upstream strip laps over the downstream strip. Install fastener pins through both strips of overlapped fabric at no less than 5-foot intervals along a line through the midpoint of the overlap, and at any other locations as necessary to prevent slippage of the fabric.

8.3.2. **Channel Lining:** Protect the fabric from damage due to the placement of the channel lining by limiting the height of drop of the material to no greater than 3 feet, or by placing a cushioning layer of sand on top of the fabric before dumping the material, at the CONTRACTOR'S option. Fabric shall not be placed until it can be covered with stone promptly to avoid damage from water, wind, and deterioration from undue exposure. The CONTRACTOR shall demonstrate that the placement technique will not damage the fabric.

8.3.2. **Subsurface Drains:** Place and shape the fabric to the sides and bottom of the trench without stretching the fabric. Protect the fabric from damage due to the placement of the crushed aggregate by limiting the height of drop of the material to no greater than 3 feet, or by placing a cushioning layer of sand on top of the fabric before dumping the material, at the CONTRACTOR'S option. Fabric shall not be placed until it can be covered with stone promptly to avoid damage from water, wind, and deterioration from undue exposure. The CONTRACTOR shall demonstrate that the placement technique will not damage the fabric. Fold the fabric over the backfilled trench and secure it with steel pins at intervals of 5 feet to produce a double thickness of fabric over the top of the trench.

SECTION IX

TECHNICAL SPECIFICATIONS

CRUSHED AGGREGATE AND CHANNEL LINING

9.1. SCOPE

This work shall consist of furnishing and placing crushed aggregate in subsurface drains, rock core drains, as backfill, on roadway(s)/driveways; and, Class II/III aggregate in the appropriate items of work, as shown on the Drawings and/or as directed by the ENGINEER.

9.2. MATERIALS

9.2.1. General: **Durable crushed limestone aggregate**, which meets the criteria set forth herein shall be used. Individual rock fragments shall be dense, sound and free from cracks, seams, and other defects conducive to accelerated weathering. Furthermore, the shape of rock fragments in the channel lining shall be angular to subrounded with a maximum 3:1 length to width ratio.

Sandstone may be used in some applications as directed by the Engineer. Where Sandstone is to be used it shall be taken to a certified laboratory and a slate durability index (SDI) completed. The SDI shall not be less than 90. SDI test shall be in accordance with ASTM D 4644-04

9.2.2. Aggregates

9.2.2.1. Friable Particles: Less than 0.25 percent by weight as determined by ASTM C 142.

9.2.2.2. Finer Than No. 200: Less than 2.0 percent by weight as determined by ASTM C 117.

9.2.2.3. Sulfate Soundness: The weight loss after 5 cycles of magnesium sulfate soundness testing shall not exceed 16 percent as determined by ASTM C 88.

9.2.2.4. Abrasion: Abrasion loss shall not exceed 40 percent as determined by ASTM C 131.

9.2.2.5. Coal and Lignite: Less than 0.5 percent as determined by ASTM C 123.

9.2.3. Channel Lining

9.2.3.1. Specific Gravity: The bulk specific gravity (saturated surface-dry) shall not be less than 2.5 as determined by ASTM C 127.

9.2.3.2. **Absorption:** Absorption shall not exceed 2 percent as determined by ASTM C 127.

9.2.3.3. **Sulfate Soundness:** The weight loss after 5 cycles of magnesium sulfate soundness testing shall not exceed 12 percent as determined by the provisions for ledge rock in AASHTO T 104.

9.2.3.4. **Dense Graded Aggregate (DGA):** DGA may be used, as shown on the Drawings and/or as directed by the ENGINEER, to augment or replace other aggregate. DGA must meet the material and gradation of the Kentucky Department of Highways "Standard Specifications for Road and Bridge Construction", current edition.

9.3. **GRADATION**

9.3.1. **Aggregate:** Aggregate for drains, backfill, and roadways shall generally be size No. 57, No. 610, and No. 2 stone. All must meet the gradation requirements of the Kentucky Department of Highways "Standard Specifications for Road and Bridge Construction", current edition.

9.3.2. **Class II Channel Lining:** Class II lining shall be produced by using a crusher, grizzly, or sieve with openings of 9-inches, and by such additional processing as may be necessary so that no more than 20 percent of the finished product will pass through a square opening of 5 inches by 5 inches.

9.3.3. **Class III Channel Lining/Cyclopean Stone Riprap:** Class III lining shall have no less than 80 percent of individual stones ranging in size from 7 to 18 inches. Stones of smaller sizes shall be permissible for use in filling voids in the upper surface and dressing to the proper slope. If stones of a larger size are used, it shall be the CONTRACTOR'S responsibility to oversize the excavated ditch to accommodate the larger stone, while achieving the configuration(s) shown on the Drawings.

9.3.3 **Shot Rock:** Shot Rock is rock left over from the completion of a blasting operation and shall range in size from $\frac{1}{2}$ to $1 \frac{1}{2}$ cubic foot or larger. This stone shall be used as directed by the Engineer to be used in rock buttress or shear keys. Shot rock to be used in channels shall be in accordance with the specific channel lining specification. Shot Rock may be limited in size by the equipment used to haul the rock.

9.4. **SAMPLING**

At least 15 days prior to delivery of material from sources other than approved Kentucky Department of Highways sources, the CONTRACTOR shall notify the ENGINEER in writing of the sources from which he intends to obtain the material. The CONTRACTOR shall provide the ENGINEER free access to the sources for the purpose of obtaining samples for testing.

9.5. **PLACEMENT**

9.5.1. **Subgrade Preparation:** The subgrade surfaces on which the stone is to be placed shall be graded to the lines and grades shown on the Drawings. Stone shall not be placed until the foundation has been inspected and approved by the ENGINEER.

9.5.2. **Placement of Channel Lining:** The appropriate sized channel lining as shown on the plan views or determined by the ENGINEER shall be used. Class II channel lining shall be used at designated locations and is not to be substituted for Class III channel lining unless directed in writing by the ENGINEER. The lining shall be placed by hand or by equipment on the surface and to the depths specified. The lining shall be constructed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials and/or damage to the underlying filter fabric. The rock shall be delivered and placed in a manner that will ensure that the lining in-place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rock and spalls filling the voids between the larger rocks.

9.5.3. **Placement of Aggregates:** DGA, No. 57 stone, No. 610 stone, and No. 2 stone shall be placed in the designated areas by equipment and struck to the neat lines and grades shown on the Drawings or as directed by the ENGINEER. DGA used for roads, subgrade, or shoulders is to be compacted, as directed by the ENGINEER, to assure a suitable surface. **Roadway stone** shall be placed ONLY with approval of the ENGINEER; both *quantities* to be placed AND *exact* locations of placement must be approved in advance by the ENGINEER. Typical applications shall consist of placement of roadway stone on residential driveways to repair "in kind" these features that have been disturbed due to normal construction activities. Also it is intended for some use, if needed, on designated access routes which lead to construction areas. HOWEVER, designated access routes shall ONLY receive roadway stone on impassable areas (i.e. soft, saturated, rutted, steep, etc.) to allow them to become "reasonably passable" and replacement "in kind" on these features that have been disturbed due to normal construction activities. Roadway stone is NOT intended as a mechanism for road improvement (i.e. improving a dirt road to gravel.)

SECTION X

TECHNICAL SPECIFICATIONS

GABIONS

10.1. SCOPE

The work shall consist of furnishing and installing rock filled, wire mesh gabions where shown on the Drawings or as otherwise directed by the ENGINEER.

10.2. MATERIALS

10.2.1. **Wire:** The wire incorporated in the lid and body of gabion units shall be constructed of galvanized steel. The mesh shall be constructed by double twisting the adjoining wire, i.e., both wires must be twisted in an interlocking, non-raveling fashion. All wire for corners, edges, selvages, and binding shall be heavily galvanized with a minimum zinc coating of 0.80 ounces per square foot of uncoated wire surface, as determined by tests conducted in accordance with ASTM A90. The tensile strength of the wire shall be at least 60,000 pounds per square inch, and the mesh must have sufficient elasticity to permit 10 percent elongation diameter of the individual wires. The following minimum wire diameters are required for non-PVC coated units only.

--Minimum Diameter--	
<u>Type / Use of Wire</u>	<u>Gabion</u>
Mesh wire	0.118
Selvedge/corner wire	0.150
Lacing/connecting wire	0.0866

10.2.2. **Course Aggregate:** The baskets shall be filled with clean, hard durable limestone from a source approved by the ENGINEER. The stone shall be well graded, with sizes ranging from a minimum of 5 inches to a maximum of 8 inches as measured in the greatest dimension; and shall otherwise conform to the Crushed Aggregate and Channel Lining section.

10.2.3. **Anchors:** Steel anchors shall be standard deformed type bars conforming to ASTM A-615. The bars shall be manufactured from new billet steel of American manufacture, and shall have minimum yield strength of 60,000 psi (Grade 60).

10.2.4. **Filter Fabric:** Conform to the "Filter Fabric" section.

10.3. FABRICATION

10.3.1. **General:** The gabion units shall be fabricated in such a manner that the base, sides, ends, and lids can be assembled at the construction site into a rectangular unit of the specified sizes.

The body of the units shall be of single unit construction; the base, ends, sides, and lids formed of a single woven mesh unit. All perimeter edges of the mesh forming the unit shall be securely selvaged so that the joints formed by tying the selvages have at least the same strength as the body of the mesh. Lacing wire shall be supplied in sufficient quantity to permit all sides, ends, and diaphragms of the body to be securely fastened, as well as to fasten the top to all sides, ends, and diaphragms of the body.

Tolerance limits for height, length, and width are ± 3 percent of the manufacturer's stated sizes.

10.3.2. **Gabions:** The gabions shall be constructed with a hexagonal weave having an opening of approximately 3 1/4 inches by 4 1/2 inches. When the gabion length exceeds its width, it shall be supplied with diaphragms to form individual cells of equal length and width. The gabion unit shall be furnished with the necessary diaphragms secured in position on the base so that no additional tying will be necessary. The diaphragms shall be of the same material composition as the gabion.

10.3.3. **Certification:** Each shipment of gabions to a job site shall be accompanied by a certification from the manufacturer, which states that the material conforms to the requirements of this Specification. The certification shall be on the manufacturer's letterhead and shall be signed by an officer of that company.

10.4. **INSTALLATION**

The foundation shall be prepared to accept the gabions as indicated on the Drawings. The foundation shall be inspected and approved by the ENGINEER. Filter fabric shall be installed and accepted, when applicable, prior to placement of the units.

Empty units shall be assembled individually on a hard, flat surface. Care must be exercised to assure that each basket is stretched or manipulated as necessary to achieve the proper rectangular shape. Sides, ends, and diaphragms must be erected and laced to ensure the correct orientation of all seams and creases. Once assembled, empty units shall be set to the lines and grades shown on the Drawings, or as directed by the ENGINEER.

All units shall be connected to the adjoining units, while empty, by lacing wire along the perimeters of their contact surfaces. Securing diaphragms, ends and sides, closure of units, and connecting adjoining units shall be accomplished by continuous stitching with alternating single and double loops at 4-inch intervals. All ends of lacing wire are to be securely fastened and not protruding.

Empty units are to be stretched, after being properly laced and connected to the adjoining unit(s), to obtain uniform alignment and to remove kinks. A standard fence stretcher, "come-along", or

other means of tensioning the unit may be used. **Adjacent rows of gabion units are to be placed such that the seams are offset.**

The units shall be carefully filled with stone by hand and/or machine to maintain alignment; to avoid bulges, damage to coating, and/or separation of units; and to minimize voids. The maximum height from which stone may be dropped into gabion units shall not exceed 36 inches. In gabions over 2-foot high, the stone is to be placed in 12-inch lifts; adjusted by hand, if necessary, to form a reasonable smooth surface, and cross-ties (or bracing wires) installed. Cross-ties are to be looped through the mesh on opposing sides of the basket, and the wire tightened by twisting.

The ENGINEER may require the CONTRACTOR to use hand labor to selectively place the layers of stone along exposed surfaces (i.e., top, front, and ends) to provide a uniform surface and an overall appearance suitable to the site-specific situation at each installation. After each unit has been filled, the lid shall be leveled as necessary. It shall be secured to the sides, ends, and diaphragms using the previously described lacing (or stitching) technique.

10.5. **ALTERNATIVE GABION SYSTEMS**

10.5.1. Welded Wire Mesh: The CONTRACTOR with the approval of the Engineer may elect to use gabion baskets manufactured from a welded wire mesh. Such baskets shall demonstrate similar or greater strengths and durability as the baskets specified by this specification. Welded wire fabric shall be composed of a series of longitudinal and transverse steel wires arranged substantially at right angles to each other, and welded together at the points of intersection by electrical resistance welding to form fabricated sheets. Gabions shall have a mesh opening of 3-inches by 3-inches with a tolerance of $\pm 1/8$ inch. Wire shall meet minimum requirements of ASTM 641, ASTM A854, ASTM 856, or ASTM 809. The minimum wire diameter shall be 0.120-inch. Spiral binders shall have a minimum wire diameter of 0.120-inch. Lacing wire shall have a minimum wire diameter of 0.087-inch. The baskets, lacing system, and entire gabion system shall be in accordance with manufacturer's recommendation.

10.5.2. Gabion Unit Fasteners: As an alternate to lacing wire, the Engineer may allow gabion unit fasteners that conform to gabion unit manufacture's recommended assembly and connection instructions.

Alternate's to the lacing wire may be used in gabion lined ditches, on all gabions to secure the shape of the gabion before placing and on horizontal surfaces where attached to each row of gabion. All vertical surfaces in retaining walls must be secured with the standard lacing wire and secured in accordance with these Technical Specifications.

SECTION XI

TECHNICAL SPECIFICATIONS

SUBSURFACE DRAINS

11.1. SCOPE

The work shall consist of furnishing all labor, materials (including rock backfill, sand, filter fabric, and pipe), equipment, and incidentals for the construction of the subsurface drains shown on the Drawings or other areas designated by the ENGINEER.

11.2. MATERIALS

11.2.1. **Pipe:** The tubing shall be high density perforated corrugated polyethylene tubing conforming to the requirements of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition, unless otherwise noted or directed by the ENGINEER. All caps, bands, and other fittings shall be made of the same material as the tubing. All pipe-to-pipe connections shall be snap-in-place bands or a split band taped in place with polyethylene tape to the satisfaction of the ENGINEER. Remote ends shall be capped with a snap-in-place cap.

When pipe is to be placed deeper than 5 feet it may be specified as a different type pipe. Subdrains deeper than 5 feet shall conform to details on the Drawings or as approved by the Engineer.

11.2.2. **Filter Fabric:** The filter fabric shall conform to the requirements of the "Filter Fabric" section of these Technical Specifications. Monofilament fabric shall be used where acid mine drainage is present or at the direction of the ENGINEER.

11.2.3. **Course Aggregate:** The drain fill shall be a No. 2 and 57 aggregate and conform to the requirements of the "Crushed Aggregate and Channel Lining" section of these Technical Specifications.

11.2.4. **Sand:** Natural sand, crushed sand and/or conglomerate sand may be used as directed by the ENGINEER.

11.2.5. **Coupling Bands:** Provide coupling bands recommended by the manufacturer.

11.2. CONSTRUCTION

Excavate the trench to a depth below the outside bottom of the plan subsurface drain elevation to allow for the placement of sufficient bedding eliminating any irregularities in the trench bottom, and to a width of at least one foot wider than the external diameter of the pipe. Place perforated pipe with the perforations in the invert. Subsurface drains shall have a **minimum slope of 1 percent UNLESS** specified otherwise. Close the upgrade ends of all subsurface drain pipe with plugs to prevent entry of debris. Equip the outlet end of subsurface drain pipe with a screen. Join perforated sections with coupling fittings or bands. Place and compact granular backfill of Size No. 2 or 57 aggregate and natural sand around the pipe ensuring that the pipe is true to line and grade and the haunches are fully supported. The remaining backfill shall be accomplished using the on-site materials, which were removed during excavation

Subdrains that are less than 5 feet in depth may be wrapped in filter fabric or may use "sock-pipe" as approved by the Engineer. When drains are greater than five feet in depth they shall use "sock-pipe" as the only option. All subdrains shall be constructed in accordance with the Drawings or as directed by the Engineer.

Sheeting and bracing, or other structural and/or special construction techniques, must be utilized, if necessary, for safety reasons.

SECTION XII
TECHNICAL SPECIFICATIONS
PORTAL CLOSURE

12.1. **SCOPE**

This work shall consist of furnishing and installing all materials, equipment, incidentals, and labor necessary to properly seal mine portals as shown in the Drawings. The ENGINEER may revise the type of closure used depending on conditions encountered at the time of construction.

12.2. **MATERIALS**

12.2.1. **Concrete:** This material shall be Class B concrete, with a 28-day compressive strength of 2500 psi, and otherwise conform to requirements of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

12.2.2. **Concrete Block:** This material shall conform to ASTM C 129.

12.2.3. **Mortar:** All mortar shall conform to the requirements of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

12.2.4. **Pipe:** All pipe shall be high density polyethelene pipe conforming to the "HDPE Pipe" section of these Technical Specifications, PVC or equivalent and conform to ASTM D 2729, except wall thickness shall conform to ASTM D 2665. Size and spacing of perforation in perforated pipe shall conform to AASHTO M 189.

12.2.5. **Rock:** The rock shall be Class II channel lining and size No. 57 stone size 8 or 9 crushed aggregate and shall conform to the "Crushed Aggregate and Channel Lining" section of these Technical Specifications.

12.2.6. **Doors:** Doors, when required, shall be 1/4 inch steel plate or equivalent equipped with suitable hinges, hasp, and padlock. The door shall be securely anchored to the concrete block and secured by a lock.

12.2.7. **Filter Fabric:** Filter fabric if applicable for the granular filter shall conform to the Filter Fabric section of these Technical Specifications.

12.2.8. **Steel Bars:** Steel bars shall be 1/2 inch steel bars welded together and shall conform to requirements of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

12.3. CONSTRUCTION METHODS

12.3.1. **General:** All debris, rubble, and other loose material shall be excavated from the mine openings in a prudent fashion prior to beginning construction of the closure. Excavation efforts shall begin at the top most of each designated portal closure and proceed incrementally downward until all of the material has been removed down to grade. As excavation work proceeds, the CONTRACTOR shall be watchful for the presence of mine water. **Any mine water detected, shall be immediately reported to the ENGINEER and excavation work halted until the ENGINEER has granted approval to proceed further.** If the ENGINEER approves work to continue, the CONTRACTOR will be required as directed to control the flow rate of all mine water effluent, to have proper drainage controls (i.e. surface ditches and pipes) in place to safely move the water throughout the project area, and take any other efforts that may be needed as not to harm any receiving streams. **Furthermore,** the ENGINEER may require treatment of mine water by applying agricultural limestone (or other chemicals) and routing it through a silt trap as directed by the ENGINEER. All treatment efforts shall remain in effect as directed by the ENGINEER.

All material except soil and rock shall be disposed of in a suitable manner beyond the limits of the project. Soil and rock may be placed in the mine openings provided they do not interfere with drainage or the construction specified in the Drawings.

The drainage pipe shall be placed in the mine opening. The pipe shall be protected by rock (No. 57 stone), then wrapped in filter fabric unless otherwise shown on the Drawings or directed by the ENGINEER. The portion of the pipe from the inside face of the wall to the outlet shall be non-perforated as shown on the Drawings. The outlet end of the pipe shall be protected with a rodent guard as shown on the Drawings. More than one pipe may be required in some openings as directed by the ENGINEER.

Following construction of the mine closure, each site is to be cleaned-up, including smoothing earth disturbance, and revegetated in accordance with the "Revegetation" section of these Technical Specifications, and shall be considered incidental to the completion of each mine closure.

12.3.2. **Rock Closures:** Rock closures shall consist of pneumatically back-stowed pea gravel or Class II channel lining and a drainage pipe placed in the opening as shown on the Drawings. Sufficient rock material shall be placed against the opening and highwall to allow proper closure of the mine workings and allowing for shrinkage or slumping of the material.

12.3.5. **Wildlife Access Closures:** Wildlife access closures shall consist of a 36" maximum or 30 " minimum HDPE culvert with a 1/2" rebar grate as shown on the Drawings. The steel bars shall be placed horizontally on six-inch centers and welded to a steel band or alternatively secured as shown on the Drawings, to allow the openings as shown on the Drawings. A minimum of 24" shall be left horizontally for the bats. Pea gravel shall be pneumatically back-stowed to secure the pipe, close the entry, and support any overhangs.

SECTION XIII

TECHNICAL SPECIFICATIONS

WATER TREATMENT AND DISPOSAL

13.1. SCOPE

This work shall consist of furnishing all equipment, labor, materials and incidentals that may be necessary to treat and discharge water from the project area in accordance with the following specification. Work will include all sampling, testing, and reporting required by the Division of Water for compliance with their Letter of Authorization, to be issued at the start of construction.

13.2. EFFLUENT LIMITATIONS

13.2.1. Sampling and Testing: Any impounded mine water encountered during the performance of the project shall be sampled and analyzed by a professional laboratory which is prepared by virtue of equipment and experience to evaluate the effluent characteristics specified below. If the impounded water is determined to contain pollutants in excess of the concentrations specified, then water treatment will be necessary before release into a receiving stream.

Periodic sampling and testing will be performed by the ENGINEER throughout the treatment and discharge process.

13.2.2. Effluent Limitations: The effluent limitations which shall determine the need for water treatment, **shall be as defined on a project-by-project basis.**

13.2.3. Noncompliance:

13.2.3.1. Maximum Concentration: In the event that the maximum pollutant concentrations specified are exceeded by any sample, the method of water treatment shall be immediately adjusted or changed to achieve compliance.

The discharge shall be resampled and reanalyzed as soon as possible to evaluate the new treatment level or procedure. If the pollutant concentrations prove to be within the specified limits, then further adjustments will not be needed. If the pollutant concentrations continue to exceed the specified limits, the ENGINEER may require that some or all other activities at the project site cease until the pollutant concentrations are within the specified limits.

Failure to meet the effluent limitations specified herein shall constitute a violation of the Federal Water Pollution Control Act and may be subject to such penalties as are provided in KRS 224.994 and 224.995.

13.2.3.2. **Average Concentration:** In the event that the pollutant concentrations specified under Average are exceeded during a calendar month, the method of water treatment shall be adjusted or changed to achieve compliance. If pollutant concentrations continue to exceed the specified limits, the ENGINEER may require that some or all other activities at the project site cease until the pollutant concentrations are within the specified limits. Failure to meet the effluent limitations specified herein shall constitute a violation of the Federal Water Pollution Control Act and may be subject to such penalties as are provided in KRS 224.994 and 224.995.

13.3. **WATER TREATMENT**

13.3.1. **General:** The CONTRACTOR shall accomplish thorough mixing of the water to be treated and the treatment agent to assure maximum contact.

13.3.2. **Treatment Agent and Method:** Water treatment shall be accomplished by the application of hydrated lime which meets ASTM Specification C-207 for type N hydrated lime. The rate shall be determined and shall be adjusted to the appropriate level by field trial.

Water from the impoundments will be pumped into an agitating tank. Hydrated lime will be added to the water and the mixture will be thoroughly mixed. Once the first batch of reagent is mixed, this process will be continuous with the mixed reagent being discharged into the suction hose of the circulating pump. The circulating pump will be situated in a manner that will cause the most even blending of treated water with untreated water. Treatment will continue until the entire pooled area has a pH of approximately nine (9).

The treated water will be allowed to settle out for **twenty-four hours** and then tested. If water is not within quality standard as set out in the contract documents, additional treatment will be applied with the same process of treatment and testing. When the water quality is acceptable for release, it will be pumped or drained from the pooled area.

13.3.3. **Alternative Treatment Agents or Methods:** The CONTRACTOR may use a treatment method or agent other than that specified, subject to the approval of the ENGINEER. The CONTRACTOR shall request in writing permission to use the alternate method or agent and shall provide any information necessary to evaluate the request.

13.3.4 **Limestone Sand Treatment:** The Engineer may require the placement of limestone sand within ditches, waterways and streams for water treatment. Temporary silt collection berms and basins should be placed downstream of the application when possible. The

limestone sand would be a minimum of 85% calcium carbonate with 100% passing a 3/8 inch sieve.

13.4. **OTHER POLLUTANTS**

During the course of this project, if it is determined that pollutants in the impounded water other than those noted in this specification occur in such concentrations as to prove deleterious to the receiving stream, the ENGINEER may require that the water treatment method or agent be adjusted or changed to provide for the treatment of the unspecified pollutant. The effluent limitations that shall pertain to any pollutants not specified herein shall be as promulgated by the U.S. EPA in 40 CFR 434.

13.5 **DISCHARGE OF WATER**

Once water has been properly treated it shall be ready for discharge from the source. In the case of impounded water, cuts to release water shall not exceed six (6") inches and the cuts shall be in original or stable ground as approved by the Engineer. The discharge of water may be halted if it causes either a hazard or potential hazard, or the water suddenly falls below the acceptable standard.

SECTION XIV

TECHNICAL SPECIFICATIONS

REVEGETATION

14.1. **SCOPE**

The work will consist of furnishing all labor, equipment, and materials for preparing the seedbed; soil amendments and seed, and their application; spreading mulch, and installing netting. All disturbed areas are to be revegetated in accordance with this Specification unless another surface treatment is specified for the area on the Drawings or elsewhere in these Technical Specifications.

14.2. **MATERIALS**

14.2.1. **Lime:** Agricultural ground limestone or its equivalent shall be used. The ground limestone must meet the following requirements: contain sufficient calcium and magnesium carbonate to be equivalent to not less than 80 percent calcium carbonate; and must be fine enough so that not less than 90 percent shall pass through a U.S. Standard No. 10 sieve; and not less than 35 percent shall pass through a U.S. Standard No. 50 sieve. Agricultural ground limestone shall be purchased from quarries approved by the Kentucky Department of Agriculture. On excavated to bedrock areas ag-lime or rock dust shall be used that meets the above standards and 100 percent shall pass through a U.S. Standard No. 50 sieve.

Because some of the lime may be applied to steep slopes, the CONTRACTOR shall be required to provide a blower or side casting type piece of equipment to apply some of this material.

All lime must be delivered to the job site only when the resident inspector is present on the site to visually inspect the delivery and receive the lime weigh tickets.

14.2.2. **Fertilizer:** The fertilizer shall be a commercial fertilizer containing the plant nutrients of nitrogen (N), available phosphoric acid (P_2O_5), and soluble potash (K_2O) at the rates specified in this section. Bagged fertilizer shall display the following information on the bag or on a sticker or tag attached to the bag: net weight, brand and grade, guaranteed analysis, and name and address of manufacturer. Bulk fertilizer (dry or liquid) shall be accompanied by a statement from the manufacturer, which contains the same information required for the bagged fertilizer. Either bagged or bulk (dry or liquid) fertilizer must be manufactured and sold under the jurisdiction of the Division of Regulatory Services of the University of Kentucky Agricultural Experiment Station.

14.2.3. **Seed:** Seed shall be applied to all disturbed areas in accordance with the seed mixture tables herein with no alterations except with the written consent of the ENGINEER.

The seed mixture shall be totally free of any quack grass, dodder, Johnson grass, Canada thistle seed, and contain less than 2 percent weed seed. The number of noxious weeds per pound shall not exceed a combined total of 30 seed per pound. The seed shall also comply with all Kentucky seed laws and regulations (KRS 205.020 to 250.170).

Seed shall be furnished fully tagged and labeled in accordance with the State laws and the U.S. Department of Agriculture Rules and Regulations under the Federal Seed Act in effect on the date of invitations for bids. All seed must be from the latest crop available. No seed will be accepted with a date of test of more than nine (9) months prior to the date of delivery to the site. Any seed, which has become wet, moldy, or otherwise, damaged in transit or storage will not be accepted.

All seed shall be delivered in separate bags or packages according to species. The ENGINEER at the site shall remove the tags from each seed bag. These tags will be required for final payment.

Pre-mixed seed will not be accepted.

All legume seed shall be treated with inoculants prior to seeding in accordance with this section of these Technical Specifications. All legume seeds shall be applied separate from all other grass seed, unless a hydraulic seeder is used.

Any and all seeding of lespedeza species (i.e., Kobe, Korean, and Sericea) will require unhulled seeding during the period of July 1 to December 31. Hulled and scarified seed will be required during the period of January 1 to June 30.

The percent of hard seed shall be considered as part of the germination rate.

See SEEDING RATE TABLE for the specified seed mix.

14.2.4. **Mulch:** Mulch shall consist of hay or straw. The mulch material shall be air dry, reasonably light in color, low in weed content, and shall not be musty, caked, or otherwise of low quality. The use of mulch that contains thistles, Johnson grass, or wild onion shall not be permitted. On excavated to bedrock areas hydro-mulch shall be cellulose fiber or processed straw.

The mulch shall be delivered only when the resident inspector is on the job site.

14.2.5. **Netting:** Plastic netting--manufactured from extruded rectangular mesh plastic, a minimum of 45" wide with approximately 3/4" x 1" mesh openings; weighing not less than 2.6 lbs. per 1000

sq. ft. shall be used. Other netting may be used if approved by the ENGINEER. Staples will be U-shaped and made from steel wire of No. W1-W1.5 or W2 as recommended by manufacturer for installation conditions. The staples shall have a minimum length of 6 inches. Staples shall be driven flush with soil surface.

14.2.6. **Tack:** Tack shall be an organic tackifier.

14.2.7. **Inoculants:** The inoculants for treating legume seeds shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the species and shall not be used later than the date indicated on the container or otherwise specified. The amount of the inoculants recommended by the manufacturer shall be used; except, when seed is applied by use of a hydraulic seeder, four times the amount of inoculants recommended by the manufacturer shall be used. Seed shall be sown within 24 hours of treatment and shall not remain in a hydraulic seeder longer than four (4) hours.

14.3. **SEEDBED PREPARATION**

Immediately following final grading, the areas to be seeded shall be dressed to a reasonably smooth, firm surface as determined by the ENGINEER. Lime shall be applied uniformly at the rate of 5 tons per acre, unless otherwise noted. Fertilizer shall be applied at the rate of 90 pounds of nitrogen (N), 230 pounds of phosphoric acid (P_2O_5), and 120 pounds of soluble potash (K_2O) per acre.

The surface shall be tilled to a minimum depth of 6 inches with either a tandem or offset disk meeting the following specifications:

- 1) Disk size: 22 inches minimum.
- 2) Disk spacing: 13 inches maximum.
- 3) Weight: 400 lbs. per foot of cut minimum.
- 4) Equipped with a drag of sufficient weight to remove any furrows left by the disk.

Seedbed preparation shall be suspended when soil conditions are not suitable for the preparation of a satisfactory seedbed. The ENGINEER shall make this determination.

On slopes too steep to disk, the CONTRACTOR shall be required to provide a dozer or equivalent to "walk-in" or break up the surface of the soil prior to seeding. This work shall be classified as seedbed preparation.

14.4. **SEEDING**

The specified mixtures of pure live seed (PLS) will be used on all disturbed areas within the project limits designated on the Drawings using the seasonal variations shown.

All areas shall be seeded immediately following seedbed preparation. In the event the date does not concur with the seeding schedules specified, seeding shall be accomplished using any one of the specified rates or an equivalent rate designed to fit the site and weather conditions, as directed by the ENGINEER.

All seed shall be broadcast evenly over the area, immediately following tilling, using a cyclone seeder, hydroseeder, or equivalent. If a hydroseeder is used, the pH of the slurry shall not be allowed to drop below a pH of 5.0. In addition, the CONTRACTOR shall provide an accurate pH meter to monitor the slurry at all times.

14.5. **MULCHING**

The mulch shall be applied uniformly over all seeded areas at the rate of 2.5 tons per acre immediately following seeding unless otherwise noted.

14.5.1. **Netting:** Mulch netting shall be installed on all slopes exceeding 30 percent. The netting shall be installed with a minimum of 6" overlap with previous row. Staples shall be installed at 4' maximum spacing on all edges and laps. Interior rows of staples shall be at 4' maximum spacing with staples spaced in the row at 8' maximum spacing. Staples in an interior row shall alternate in spacing with staples on an adjacent interior row. All staples shall be driven flush with the soil surface. The ENGINEER may approve the use of netting on areas which are flatter than 30 percent if the CONTRACTOR requests.

14.6. **AREAS EXCAVATED TO BEDROCK**

On all areas where soil material has been removed to bedrock, the following procedure is required. The area will be hydro-seeded using a hydraulic seeder. The seeding rate and species as well as the fertilizer rate shall be as specified in this section of these specifications. Ag-lime or rock dust meeting the requirements of this section and 100 percent shall pass through a U.S. Standard # 50 sieve shall be applied at a rate of 1 ton per acre. Hydro-mulch, either cellulose fiber or processed straw, shall be used and applied at a rate of 1,500 pounds per acre. No seedbed preparation or netting is required on these areas.

14.7. **RESIDENTIAL YARD AREAS**

In areas around houses, lime, fertilizer, and seeding rates will vary and additional seedbed preparation work will be required for revegetation of yard areas. Hydrated lime (90 percent Ca O₃ content and 85 percent passing a #200 sieve) shall be applied at a rate of 20 pounds per 1000 square feet. Fertilizer will be applied at a rate of 15 pounds per 1000 square feet using a "10-10-10" fertilizer. Seed shall consist of an equal mixture of Creeping Red Fescue and Perennial Ryegrass, and shall be applied at a combined rate of 4 pounds (PLS) per 1000 square feet. Additional seedbed preparation shall be required to remove all rock and debris larger than 2" (two inches) and to rake the area to a completely smooth surface. Hand raking and tilling will be required.

14.8. LANDSCAPE ALLOWANCE

This shall consist of replacement "in kind" of any landscape in and around residential areas as part of normal construction techniques to facilitate the completion of other construction bid items. When approved, landscape to be replaced shall be of same species. To qualify for reimbursement, advanced approval from the ENGINEER must be given for removal and subsequent replacement. Any landscape damaged due to CONTRACTOR carelessness shall be replaced "in kind" at the CONTRACTOR'S expense.

14.9. CRIMPER

On all designated areas that require crimping, a crimper meeting the following specifications will be used.

1. Minimum disk size: 20 inches
2. Minimum depth spacing: 8 inches
3. Maximum depth of crimping: 3 inches
4. Minimum weight: 1,300 lbs. (this weight can be increased at the discretion of the ENGINEER if soil conditions warrant such an increase)

Crimping must be performed immediately following mulching.

SECTION XV

TECHNICAL SPECIFICATIONS

UTILITY RELOCATION

15.1. SCOPE

The work shall consist of the required relocation/replacement of existing utilities in order to facilitate construction. Work may possibly includes relocation of utility poles and lines, water lines, gas lines, sewer lines, or septic systems as shown on the Drawings, or encountered during approved construction activities.

15.2. **GENERAL:** All work shall be completed by the appropriate utilities or under their supervision and in accordance with their guidelines and regulations. The CONTRACTOR shall be responsible for making appropriate arrangements regarding utility relocations and shall coordinate such activities to ensure timely completion of the individual components of the entire project. All such activities are to be performed under the direction and with the approval of the ENGINEER. A genuine effort must be made to prevent any disturbance of service; in the event such disruption occurs, the CONTRACTOR must immediately correct same.

15.3. UTILITY POLES AND LINES

The utility poles shall be relocated if -- in the opinion of the ENGINEER -- excavation has progressed such that the pole is limiting construction or if the stability of the pole has been jeopardized due to the excavation. Guy wires and anchors may be relocated in the event that they are disturbed during the excavation process while leaving the pole undisturbed.

15.4. WATER LINES, GAS LINES, AND SEWER LINES

If water lines, gas lines, or sewer lines must be relocated to facilitate construction of ditches, installation of culverts or completion of other facets of construction, then relocation shall be made in accordance with the appropriate utility company regulations.

15.5. SEPTIC SYSTEMS

The CONTRACTOR shall be responsible for physically locating and determining the operating condition of all existing septic systems (i.e. tanks, leach beds, and inflow lines) within the project limits. Every reasonable effort shall be taken not to disturb septic systems, which are located within defined construction limits or along access routes. In situations where this is not feasible, the CONTRACTOR shall receive approval from the ENGINEER prior to working on or through any existing system. If construction activities cannot be completed without disturbance to a septic system, then the CONTRACTOR shall repair or replace the

septic system with one, which meets the approval of the ENGINEER as well as all local & state governing authorities.
In designated waste areas, no septic systems shall be disturbed in any fashion without the express prior approval of the ENGINEER.
This includes filling on or traversing across with equipment.

SECTION XVI

TECHNICAL SPECIFICATIONS

BITUMINOUS REPAIR

16.1. SCOPE

The work shall consist of the resurfacing of paved, public roads disturbed or damaged as a direct consequence of achieving the requirements of these Contract Documents. This specification is generally intended to provide for the replacement of pavement disturbed as a part of the work, such as culvert installation or the transporting of construction materials to the job site.

At the ENGINEER'S discretion, the requirements of this specification may also apply to other damages to non-state-maintained roads, such as potholes and rutted areas, when -- in the opinion of the ENGINEER -- such damages are unavoidable in the prudent and practical accomplishment of the various items of work required to complete the Project. However, any damages to state-maintained roads and damages to non-state-maintained roads caused by negligence of the CONTRACTOR shall be the sole responsibility of the CONTRACTOR. Such damages shall be repaired to the satisfaction of the ENGINEER and the COMMONWEALTH shall incur no additional expense therefore.

Roads, bridges, and/or crossings on which the COMMONWEALTH will be reimbursing the CONTRACTOR for possible repairs and corrections associated therewith will be, insofar as possible, designated on the Design Drawings, and discussed at the "Prebid" showing of Project. Nonetheless, it shall be the CONTRACTOR'S responsibility to solicit clarifications and/or instructions from the ENGINEER on a site-specific basis prior to mobilizing to the individual sites.

16.2. GENERAL

Resurfacing and/or repair work shall be scheduled and conducted in such a manner to assure adequate flow of local traffic at all times.

16.2.1. **Resurfacing:** Resurfacing work shall consist of an asphalt overlay of bituminous concrete surface mix compacted to a **minimum thickness of one (1) inch** over the existing pavement surface. Increased thickness placement may be specified if one-inch minimum placement is not adequately repairing the surface "in kind" as determined by the ENGINEER--increased placement thickness shall be at the sole discretion of the ENGINEER. Leveling and tacking of the existing pavement shall be performed, as directed by the ENGINEER, to prepare the existing pavement or prepared surface for the resurfacing operation.

Segments of pavement slated for resurfacing which are severely rutted, broken, or otherwise damaged shall be repaired as directed by the ENGINEER, prior to resurfacing.

16.2.2. **Repair:** Roadway repair shall consist of the patching of potholes and rutted areas created by construction activity during the course of the Project. The ENGINEER shall determine the limits of pavement area to be repaired and the time period for repairs.

Repairs shall be made by excavating pavement areas to a minimum depth of 10 inches from the existing pavement surface elevation. The excavation shall be backfilled with a minimum 6-inch layer of dense graded aggregate compacted to no less than 8 percent of the solid volume throughout the layer. The dense graded aggregate shall be topped with a minimum of 4 inches of bituminous concrete surface mix placed and compacted in accordance with these Technical Specifications.

16.3. **MATERIALS**

16.3.1. **General:** All bituminous materials used in the resurfacing operation shall meet the requirements of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

16.3.2. **Dense Graded Aggregate:** Dense graded aggregate used in patching operations shall meet the requirement of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

16.3.3. **Leveling and Patching:** The bituminous mixture used for leveling and patching shall consist of the same bituminous concrete surface mix used in the resurfacing operation (**see subsection 16.3.5.**).

16.3.4. **Tack and Prime:** Any of the following emulsions are permitted for use as a tack material: SS-1, SS-1h, CSS-1, CSS-1h, AE-60, RS-1, or CRS-1. Primer-L shall be furnished as the bituminous material for prime. All tack and prime materials shall meet the applicable requirements of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition. Cut back asphalts may be used only with the written permission of the ENGINEER, and shall be in conformance with all applicable laws and regulations concerning air pollution control.

The temperature limitations for applying prime and tack coats shall be that specified for the type of construction with which such work is included. Prime and tack coats shall not be applied to wet surfaces.

When RS-1, or CRS-1 is furnished for tack they shall be applied undiluted at the rate of 0.4 pound (0.05 gallon) per square yard, unless otherwise specified in the requirements for the bituminous mixture being placed. When SS-1, SS-1h, CSS-1, CSS-1h, or AE-60 is furnished for tack the material may be applied without dilution providing uniform and satisfactory coverage is achieved. Unless otherwise specified in the requirements for the bituminous mixture being placed, the application rate for undiluted SS-1, SS-1h, CSS-1, CSS-1h, or AE-60 shall be 0.4 pound (0.05 gallon) per square yard.

Prime coats shall be applied at the rate specified in the Plans, or as directed by the ENGINEER, when conditions justify variations in the rates of applications.

At the time of application, the temperature in degrees Celsius (Fahrenheit) of prime and tack materials shall be within the ranges shown in the Tables herein:

PRIME

Primer L	16-49 (60-120)
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TACK

SS-1, SS-1h, CSS-1	
CSS-1h, AE-60	21-71 (70-160)
RS-1, CRS-1	21-60 (70-140)

On projects over which public traffic is being maintained, the tack coat shall be applied over one-half of the pavement width not to exceed one-half day's work in advance of the construction of the bituminous cover course; provided, that at no time shall the tack coat application end at a location hazardous to traffic. Tack coat application requiring an overnight lane closure will not be allowed. The work shall be arranged so that at the end of runs all tack shall be covered with the bituminous mat.

The CONTRACTOR shall provide necessary barricades, warning signs, and flagmen to ensure against traffic traveling over freshly applied prime or tack coat.

16.3.5. **Resurfacing Material:** Resurfacing material shall consist of Bituminous Concrete Surface, Class I, using coarse aggregate meeting the requirements of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition. Natural conglomerate, crushed slag, crushed granite, crushed siliceous gravel, or crushed sandstone sand will be required in the proportions of no less than 25 percent of the total combined fine and coarse aggregates in Bituminous Concrete Surface, Class I.

At least 10 days prior to the resurfacing operation, the CONTRACTOR shall supply the ENGINEER in writing with information concerning the composition of the surface mix intended for use as well as the source from which he intends to obtain the material.

16.4. **PAVEMENT CONSTRUCTION**

16.4.1. **General:** All equipment, pavement methods, and general procedures relative to the repair and resurfacing operations shall be in accordance with the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

16.4.2. **Spreading:** Bituminous concrete surface mix shall be maintained at a temperature of **225 degrees (F)** during placement and shall be spread with a paver meeting the requirements of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition. The paver shall spread the mixture without tearing the surface and shall strike a finish true in density and texture and free of irregularities. The use of small hand tools shall be held to a minimum except where patching and leveling are necessary.

16.4.3. **Compaction:** Compacting shall be conducted in accordance with the appropriate section of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition, using self-propelled rollers meeting the requirements of the appropriate section thereof. The surface mix shall be compacted to a minimum density of 95 percent of the optimum density as determined by the Marshall Method. The ENGINEER shall conduct Field density tests during the resurfacing operation to verify the proper density. Adjustments in the compactive effort shall be made based on these field density tests.

16.4.4. **Weather Limitations:** Bituminous concrete surface mix shall not be placed on any wet surface; when the ambient air temperature is below **40 degrees (F)**; or when weather conditions otherwise prevent the proper handling or finishing of the bituminous mixture.

SECTION XVII

TECHNICAL SPECIFICATIONS

TRAFFIC CONTROL

17.1. SCOPE

This item consists of providing traffic control on all public adjacent to the project areas, including the placement of two flag persons, signs, markers, and barricades as may be required. The CONTRACTOR shall develop a traffic control plan for the review and approval of the ENGINEER.

17.2. CODES AND STANDARDS

Traffic shall be maintained in accordance with the standards set forth in the Federal Highway Administration's "Manual on Uniform Traffic Control Devices", current edition; and the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition; and Standard Drawing No. TSC-202, current edition.

17.3. TRAFFIC CONTROL DEVICES

All traffic control devices shall meet the above requirements. Such devices shall be placed starting and proceeding in the direction of the flow of traffic and removed starting and proceeding in the direction opposite to the flow of traffic. The ENGINEER and the CONTRACTOR, or their authorized representatives shall review the signing before any lane closures are constructed. Warning signs for construction shall be diamond shaped (square with one diagonal vertical), having a black symbol or message on an orange background. A minimum size of **36 inches by 36 inches** may be used for Construction Approach Warning Signs, provided that a minimum **letter size of 5 inches** can be accommodated on this size. All other Traffic Control signs, symbols, dimensions, and markings shall conform to the size and shapes as shown in the "**Manual on Uniform Traffic Control Devices**". The ENGINEER shall approve all signing on a case-by-case basis before such work can begin.

17.4. MISCELLANEOUS REQUIREMENTS

The CONTRACTOR shall cover any signs, either existing or temporary, which do not properly apply to the current traffic phasing; and shall maintain such coverings until the signs are applicable or are to be removed.

The CONTRACTOR'S vehicles shall always move with and not against the flow of traffic on all public roads. Vehicles shall enter and leave affected areas of pavement in a manner which will not be hazardous to nor unduly interfere with normal traffic flow.

Construction vehicles shall not park or stop along the roadway, except within areas designated by the ENGINEER.

17.5. **TRAFFIC COORDINATOR**

The CONTRACTOR shall designate an employee to be traffic coordinator, if such is required, or if the need for such individual designation as becomes apparent as determined by the ENGINEER. The traffic coordinator shall be responsible for supervising the traffic control operations, policing the traffic control area, and reporting all related incidents to the ENGINEER. The CONTRACTOR shall furnish the name and telephone number where the traffic coordinator can be contacted at all times.

SECTION XVIII

TECHNICAL SPECIFICATIONS

FENCE

18.1. SCOPE

This work shall consist of furnishing and constructing fence(s) of the height, type, and at the location specified in the Drawings or as directed by the ENGINEER.

18.2 GENERAL

Fence shall involve the construction of fences as either safety fence, property fence or replacement fence. In all cases fences shall be as required by the Drawings or as directed by the Engineer. If an existing fence is encountered during construction that has not been identified on the drawings then it should be determined what type of fence it is, then proceed as directed by the Engineer. In most all cases we will attempt to match the existing fence.

18.2.1. Safety Fences: Safety Fences (chain link or woven wire) are the ones to be used to prevent injury to the general public. In general Safety Fences will be placed along the top/front of retaining walls, highwalls, and other various places that may cause a potential hazard to the public as determined by the ENGINEER.

18.2.2. Property Fences: Property Fences are the fences that will be disturbed in the process of doing the work required by the Drawings or as directed by the Engineers. Where a fence exists between two or more property owners the fence shall be treated as a property line and surveyed and referenced before construction begins. Once construction is complete the fence line shall be resurveyed and a new fence placed at the exact location of the previous fence. Also where property point(s) are existing in the field they shall be surveyed and referenced so that they may be reestablished following construction. **However Abandoned Mine Lands does not state nor infer reestablishment of said features to be the true property boundary corners and/or lines—establishment of property boundary corners and lines are beyond the scope of this effort. See Structure Removal/Replacement Section for further information regarding property fences.**

18.2.3. Replacement Fences: Replacement fences are those fences (e.g. farm fence) located in the field that are clearly not property fences or safety fences but are those fences that will be disturbed in the process of doing the construction called for in

the drawings. **See Structure Removal/Replacement Section for further information regarding replacement fences.**

18.2. **MATERIALS**

18.3.1. **Chain-Link:**

18.3.1.1. **Chain-Link Fabric:** Use 0.148-inch nominal diameter wire woven in 2-inch mesh. Coat Type I fabric to conform to Class D. Furnish fabric for fences 4 feet and 6 feet high that has the top selvages knuckled and bottom selvage knuckled or twisted and barbed. Furnish fabric for fences 8 feet high or higher with both top and bottom selvages twisted and barbed.

18.3.1.2. **Post Caps and Socket Type Brace Connections:** Post, Rails, Gate Frames, and Expansion Sleeves. With zinc-coated steel fabric or with aluminum-coated steel fabric, use either zinc-coated steel or zinc-acrylic coated steel. With aluminum alloy fabric, use aluminum alloy. Furnish steel posts that comply with Subsection 816.07.01.

18.3.1.3. **Fabric Ties:** Use either a minimum 0.148-inch nominal diameter aluminum alloy or 0.120-inch nominal diameter galvanized steel.

18.3.1.4. **Hog Rings and Tension Wire:** With zinc-coated steel fabric or with aluminum-coated steel fabric use zinc-coated steel wire or aluminum-coated steel wire. Ensure that steel ties and wire conform to ASTM F 626, except that the minimum weight of coating is 0.6 ounces per square foot. With aluminum alloy fabric, use aluminum alloy wire.

18.3.4.5 **Miscellaneous Fittings and Hardware:** With zinc-coated steel fabric or with aluminum-coated steel fabric use zinc-coated steel. With aluminum alloy fabric, use aluminum alloy.

18.3.2. **Woven Wire:**

18.3.2.1. **Woven Wire Fabric:** Use either zinc-coated steel or aluminum-coated steel. Provide the type and size and style specified in the Contract. Zinc-coated fabric shall conform to ASTM A 116 and aluminum-coated fabric to ASTM A 584. If barbed wire is used it shall be either zinc-coated steel , aluminum coated steel or aluminum alloy in accordance with KYTC Standard Specifications for Road and Bridge Construction. Use barbs of 4-point pattern spaced at intervals of 5 inches.

18.3.2.2. **Posts and Braces:** Posts and braces shall be either steel posts/braces conforming to ASTM F 1043 and ASTM F 1083 or treated wood posts/braces conforming to either AWPA C 5 or AWPA C 2.

18.3.2.1.1. **Brace Wire:** Shall conform to ASTM A 777-91 except provide a minimum weight coating of 0.6 ounce per square foot. Use size 0.148-inch nominal diameter or larger.

18.3.2.2. **Fabric Ties:** Use either a minimum 0.109 nominal diameter galvanized steel conforming to ASTM F 626 except ensure that the minimum weight of coating is 0.6 ounce per square foot or 0.148-inch nominal diameter aluminum alloy.

18.3.3. **Concrete:** Concrete shall be Class B concrete conforming to the Reinforced Concrete Section of these Technical Specifications.

18.3. **CONSTRUCTION**

Before starting fencing operations, remove all brush, stumps, logs, and debris that will interfere with the proper construction of the fence. Remove or trim sound standing trees in the fence line as directed. Construct fence with new materials according to the Standard Drawings and as specified in this section. Install fence as one of the first construction operations. Where it is impractical to install fence initially in its final form or location, construct a suitable temporary fence or to delay fence erection until the permanent fence may be erected. Where tying fence to a new structure, erect a temporary fence until the structure is complete and the permanent fence can be anchored to the structure in the manner specified in the Plans. Install fence at locations specifically indicated on the Plans or as instructed by the ENGINEER. Install fence facing the property owner except on horizontal curves. On horizontal curves, install the fence to pull against all posts. Apply sufficient tension between pull posts to make the fence stock tight. Install pull posts at all breaks in horizontal alignment of the fence, and at sharp breaks in vertical alignment. For tangents and curves up to one degree, space pull posts a maximum of 500 feet on centers; ensure that curves over one degree to 4 degrees have pull posts spaced a maximum of 250 feet on centers; and curves over 4 degrees have pull posts installed each time the angle of deflection increases 5 degrees.

18.3.1. **Setting Posts:** Set all posts at the required depths and intervals designated in the Plans or Standard Drawings. Set posts plumb and in true alignment on the side where the wire is attached. Dig holes for posts to full depth and with sufficient diameter to allow placement of concrete. When encountering solid rock at grade or below, drill a hole one foot deep and slightly larger than the outside dimensions of the post or brace in the rock, and concrete in the post. At line posts where top of rock is 8 inches or less below grade, remove the anchor plate. Field cut posts and braces to fit maximum depth whenever encountering solid rock. Set all end, gate, corner, and pull posts, and anchor them in concrete placed to the top of the ground, finished smooth, and sloped to drain. Brace all end, gate, and corner posts. Brace pull posts in two directions. Brace corner posts in the direction of each line

of the fence. Anchor the metal braces from the metal posts in concrete that is crowned at the top to shed water. Brace concrete posts with a pole or bar of the same type of material as the post. Loop galvanized smooth wire having a minimum diameter of 0.148 inch around the braced post near the ground, and then loop it around the line post at 12 inches below its top continuing between the posts until four strands of wire are in place and the ends of the wire are securely fastened together. Then twist the strands of wire together until the brace pole is in compression. Do not allow the compression to be great enough to cause lateral springing in the brace pole. Allow concrete anchors to cure for at least 5 days before erecting the fence.

Where safety fences are called for on concrete walls the posts shall be bolted to the front of the wall. Posts shall not be set on the top of the concrete walls.

18.3.2. **Fencing:** Tie any intersecting fence to an independent pull post. Stretch fence fabric taut and securely fasten it to each post. Accomplish stretching with a stretcher that will produce equal tension in each line wire. Stretch fabric until the tension is just below the point of producing displacement in the tension crimps. At each end, corner, or gate post, cut and turn each strand of line wire around the post and tie it back to itself with no less than 3 turns. When it is necessary to splice 2 sections of fence, make the splice by placing together the end stay wires of each section, and twist the end of each line wire around the stay wires and back onto itself with no less than 3 turns; or splice the fence by using ENGINEER approved splicing sleeves designed for that purpose. Attach the fence to each wood post with a staple for each line wire and as many additional staples as necessary to firmly secure the wire. Use tension wires and rails in erection of fences to stretch the fabric. When shown on the Standard Drawings, place, stretch taut, and secure at ends the top or bottom tension wires to all posts in a manner before placing fabric. When a top rail is required, secure the bar at each end before stretching and tying the fabric. Secure ends of the fabric with stretcher bars threaded through the loops of the fabric and secured to the posts by means of clamps with bolts and nuts. Use the number of clamps as indicated. Place the fabric by securing one end and applying sufficient tension to remove all slack before making attachments elsewhere. Fasten the fabric to the line posts and to the top tension wire or to the top rail, with tie wires or bands. Determine the number of tension bands required per post of fence by taking the height of the fence in feet and subtracting one. Space tie wires for attaching fence to the top tension wire or top rail on 24-inch centers. Space tie wires for attaching fence to intermediate or line posts on 14-inch centers. Space tie wires on chain link gates on 24-inch centers (when applicable). Install the chain link fence around utility installations facing the highway with the barbed wire arms at a 45-degree angle extending toward the highway. Design and install post caps for all tubular posts to exclude moisture from inside the posts, and

install socket type brace end connections to exclude moisture from inside the rails.

18.3.3. **Gates:** Erect gates at locations specified in the Plans or as the Engineer directs. Erect the gate plumb with its hinges firmly attached to the post and to the gate. Allow the gate to swing freely when opened. Install the latch so it works easily and secures the gate when closed.

18.3.4. **Finishing:** Ensure that the tops of all posts are at a uniform height above the ground or at a uniform distance above the top of the chain-link fabric. Ensure that the finished fence is true to line, taut, and solid at all points. Dispose of all surplus excavated material and other debris resulting from construction and leave the fence line with a neat and orderly appearance.

SECTION XIX

TECHNICAL SPECIFICATIONS

TEMPORARY LOW WATER CROSSING

19.1. SCOPE

This work shall consist of constructing a temporary low water crossing at locations depicted on the drawings for the safe passage equipment and materials. Included is all maintenance and complete removal of item at the completion of work.

19.2. MATERIALS

19.2.1. Course Aggregate: Shall consists of durable crushed limestone aggregate, which meets the criteria set forth in the Crushed Aggregate and Channel Lining specification for various gradations needed as approved by the ENGINEER.

19.2.2. Pipe: Shall consist of an inside diameter of 24" minimum and 36" maximum and be of significant strength to withstand all anticipated loads throughout the duration of the project. The ENGINEER reserves the right to reject any pipe(s) not meeting any criteria set forth herein.

19.2.3. Concrete: Concrete shall be Portland cement, water, fine aggregate, and coarse aggregate. The concrete mix shall be designed so that the compressive strength test will yield a 28-day minimum compressive strength of 3500 psi conforming to ACI 318.5.6.2.3.

19.2. CONSTRUCTION REQUIREMENTS

The low water crossing(s) shall be constructed as depicted/described in the Drawings and in accordance with Kentucky Division of Water Guidelines Floodplain Management Branch. The crossing shall be maintained throughout the construction period as directed by the ENGINEER. All gradework leading to and from the crossing shall be considered incidental to this item. All pipes shall be regularly inspected and cleaned as needed to ensure maximum hydraulic capacity during the project duration. Any failing pipes shall be removed and replaced as directed by the ENGINEER. The CONTRACTOR is advised that the channel bottom dimension and number of pipes shown on the low water crossing detail drawing is approximate; the CONTRACTOR shall satisfy himself as to the amount of resources and materials needed to complete the work within the guidelines set forth. At the completion of the project, the crossing (concrete, aggregate, and pipes) shall be completely removed as directed by the ENGINEER with all disturbed areas return to preexisting conditions (i.e. existing topography configuration of area in and around the low water crossing area) and revegetated.

19.3. **KY DIVISION OF WATER-FLOODPLAIN MANAGEMENT GUIDELINES**

1. There shall be a maximum fill height of four and one-half (4½) feet measured from the channel bottom to the top of the proposed crossing.
2. The pipes used for the proposed crossing **shall not be less than 24" in diameter** or more than 36" in diameter.
3. There **shall not be more than one (1) foot spacing between the pipes** measured between the outside edges of the pipes.
4. As many pipe as possible shall be placed within the stream banks.
5. Fill material used to cover the pipes shall be composed entirely of clean rock or concrete. No soil shall be allowed in the fill.
6. All pipes shall be laid flush with the bottom of the stream channel.
7. The maximum cover over the top of the pipe shall not be greater than eighteen (18) inches.

SECTION XX

TECHNICAL SPECIFICATIONS

GROUT

20.1. **SCOPE**

This work shall consist of furnishing all materials, equipment, and labor necessary for placing grout as shown on the drawings and as directed by the ENGINEER.

20.2. **MATERIALS**

20.2.1. **Grout:** Grout shall consist of a mixture of Portland cement, fine aggregate, and water. Portland cement shall be Type II conforming to ASTM C 150. Fine aggregate shall consist of inert natural sand conforming to ASTM C 33 or C 404. Water shall be clear, fresh, and free from injurious amounts of oil, acid, organic matter, or other deleterious substances. Maximum net water content per bag of cement shall be 6 gallons. The materials shall be proportioned to provide a minimum 28-day compressive strength of 3,000 psi.

SECTION XXI

TECHNICAL SPECIFICATIONS

ACCESS GATE

21.1. SCOPE

The work shall consist of furnishing all materials, equipment, and labor necessary to construct the access gate (or barriers) at the locations and in accordance with the details shown on the Drawings.

21.2. TYPES

21.2.1. Farm Gates: The gates and supports shall be made of either 1 3/4" diameter welded tubular steel (6 bars) or 5 5/8" wide galvanized panels (5 panels).

21.2.2. Pipe Gates: Pipe gates and there supports shall be made of a 2 1/2" diameter schedule 40 steel.

21.2.3. Cable Gates: Cable gates shall be made of 1" diameter steel cable with appropriate clamps.

21.3. MATERIALS

21.3.1. Pipe: The gate and supports shall be constructed of schedule 40 steel pipe -- 2 1/2" diameter, except the "swing sleeve" which shall be 3" diameter pipe.

21.3.2. Plate Steel: Top plates, stop plates, and lock plates shall be fabricated of 3/16" steel plate.

21.3.3. Concrete: Posts shall be set in Class B Concrete, as shown on the Drawings, which has a 28-day minimum compressive strength of 2500 psi, and which otherwise conforms to Section 601 of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

21.3.4. Posts: Posts shall be either 6" diameter pipe, 12" diameter treated post or 8" x 8" treated posts, each set in concrete with the appropriate hinges and lock plates.

21.3.5. Hinges: Hinges shall be appropriate to the type of gates and posts used to construct the barrier and as approved by the ENGINEER.

21.3.6. Locks: Locks shall consist of an appropriate commercial lock and either chain or lock plate(s). Locks shall have four keys (two to the property owner and two to the Commonwealth).

21.3.7. **Signs:** When required, signs attached to the gates shall be installed as shown on the Drawings or as directed by the ENGINEER.

21.3.8. **Grout:** Grout shall consist of a mixture of Portland cement, fine aggregate and water. Portland cement shall be Type II conforming to ASTM C 150. Fine aggregate shall consist of inert natural sand conforming to ASTM C 33 or C 404. Water shall be clear, fresh and free from injurious amounts of oil, acid, organic matter or other deleterious substances. Maximum net water content per bag of cement shall be 7.5 gallons. The materials shall be proportioned to provide a minimum 28-day compressive strength of 2500 psi.

21.3.9. **Fence:** The fence shall be woven wire, either aluminum coated steel No. 1047-6-9 or zinc coated steel No. 1047-6-9. All corner posts, intermediate posts, and accessories shall be fully galvanized coated. All fence fittings shall comply with ASTM F 626.

21.4. **CONSTRUCTION**

Upon completion of the access gate the ENGINEER shall determine the need and exact locations for the fencing. The fencing shall be erected and installed in accordance with the manufacturer's recommendations. The CONTRACTOR shall be responsible for placement of 2 cubic feet of grout at each post. The CONTRACTOR shall make sufficient provisions, which will allow the posts to be set at specified depths and alignment. The fence shall be erected after completion of all other work items in the vicinity.

21.5. **FABRICATION**

All elements of the gate/barrier shall be shop fabricated, except the top plate for the hinge (swing) post may be field welded. The welding material and procedures shall comply with the American Welding Society's Structural Welding Code D1.1, current edition, with modifications and/or additions as may be stated on the Drawings or as directed by the ENGINEER.

21.6. **INSTALLATION**

21.6.1. **General:** Installation shall be in accordance with the detail as shown on the Drawings.

21.6.2. **Painting:** All steel materials shall be field cleaned and painted, unless otherwise directed by the ENGINEER, in general conformance with the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

SECTION XXII

TECHNICAL SPECIFICATIONS

CONCRETE HEADWALLS

22.1. SCOPE

This work consists of construction of the concrete headwalls at the locations shown on the Drawings and furnishing the labor, materials, and equipment incidental thereto.

22.2. GENERAL

The headwalls, as shown on the Drawings shall be fabricated in accordance with the Kentucky Transportation Cabinet's "Standard Drawing Numbers RDH-110, RDH-210 and RDH-310", current edition. Pre-cast units shall be accompanied by manufacturer's certification showing compliance with these requirements.

22.3. MATERIALS

The concrete used shall be Class A concrete with a 28-day compressive strength of 3500 PSI, and otherwise conforming to the reference sections of the Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

22.4. CONSTRUCTION

The headwall construction shall be accomplished in accordance with the details shown on the Drawings and at elevations and locations established by the ENGINEER, and in conformance with standard practices as presented in the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

SECTION XXIII

TECHNICAL SPECIFICATIONS

DROP BOX INLET

23.1. **SCOPE**

This work consists of construction of drop-box inlets at locations shown on the Drawings and furnishing the labor, materials, and equipment incidental thereto.

23.2. **GENERAL**

The headwalls, as shown on the Drawings shall be fabricated in accordance with the Kentucky Transportation Cabinet's "Standard Drawing Numbers RDH-110, RDH-210 and RDH-310", current edition. Pre-cast units shall be accompanied by manufacturer's certification showing compliance with these requirements.

3500 psi concrete for pavement restoration shall be accomplished in accordance with the details shown on the Drawings.

23.3. **MATERIALS**

Concrete: The concrete used shall be Class A concrete with a 28-day compressive strength of 3500 PSI, and otherwise conforming to the Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.

23.4. **CONSTRUCTION**

The headwall construction and placing the 3500 PSI concrete for pavement restoration shall be accomplished in accordance with the details shown on the Drawings and at elevations and locations established by the ENGINEER, and in conformance with standard practices as presented in the Kentucky Transportation Cabinet's "Standard specifications for Road and Bridge Construction", current edition.

SECTION XXIV

TECHINICAL SPECIFICATION

SHOTCRETE

24.1 **SCOPE**

This work shall consist of constructing a pneumatically applied shotcrete blanket onto rock/soil surfaces at locations shown on the plans or as directed by the engineer.

These specifications refer to premixed cement and aggregate pneumatically applied by suitable equipment and competent operators.

24.2. **Qualifications of Contractor**

At least 30 days prior to beginning shotcrete work, the contractor shall provide written evidence that the supervisor, nozzle operator, and delivery equipment operator have performed satisfactory work in similar capacities elsewhere for a sufficient length of time to be fully qualified to perform their duties.

The supervisor shall not have less than 2 years' experience as a shotcrete nozzle operator. The nozzle operator and delivery equipment operator shall have served at least 1 year of apprenticeship on similar applications with the same type of equipment. Prior to the start of shotcreting for this job, nozzle operators shall, in the presence of the engineer, demonstrate their ability to apply shotcrete of the required quality on a test panel. One satisfactory test panel shot in a vertical position for each mix design used during the course of the work shall be the minimum qualification test for nozzle operators before they will be permitted to place shotcrete.

24.3. **Materials**

28.3.1. **Shotcrete:** Shotcrete shall be composed of portland cement, fine and coarse aggregate, and water. Either wet-mix or dry-mix shotcrete may be used. The shotcrete shall be reinforced with either welded wire fabric or steel fibers.

The shotcrete shall be applied according to these specifications and applicable sections of the American Concrete Institute's Guide to Shotcrete (ACI 506R-85).

The contractor shall be responsible for the design of shotcrete mixes and for the quality of shotcrete placed.

24.3.2. **Prepacked:** Premixed and prepackaged concrete product, with or without steel fibers, specifically manufactured as a shotcrete product may be provided for on-site mixed shotcrete, if approved by the engineer. The packages shall contain cement, aggregate and if appropriate, steel fibers conforming to the materials portion of this specification.

24.3.3. **Admixtures:** Admixtures shall not be used without permission

of the engineer. If admixtures are used to entrain air, reduce water-cement ration, retard or accelerate setting time, or accelerate the development of strength, they shall be used at the rate specified by the manufacturer and must be compatible with the cement used. Use of calcium chloride accelerating agent will not be permitted. When used, admixtures shall be dissolved in water before introduction into the mixture. Any color additive shall be approved by the engineer before use. Final acceptance will be made following a test section that has been allowed to cure for at least 4 days.

24.3.4. **Water:** In addition to the requirements set forth in the Standard Specifications, the water used in the shotcrete mix shall also be free of elements which would cause staining.

28.3.5. **Aggregates:** The combined gradation of fine and coarse aggregate used in the shotcrete shall meet the following grading requirements:

Sieve Size	Percent Passing by Weight
½" (12.7mm)	100
3/8" (9.7mm)	90 to 100
No. 4	70 to 85
No. 8	50 to 70
No. 16	35 to 55
No. 30	20 to 35
No. 50	8 to 20
No. 100	2 to 10

24.3.6. **Steel Fiber Reinforcement:** When the plans or specifications require the use of steel fiber reinforced shotcrete, the steel fiber reinforcement shall meet the following requirements. Steel fibers shall have a length between 1 and 1 3/8 inches (35.1mm), have blunt or hooked ends, have a length to diameter ratio of less than 80, and shall be cold drawn carbon steel with a minimum tensile strength of 160,000 psi. Only steel fibers manufactured specifically for use in shotcrete applications will be allowed. The steel fiber content shall not be less than 100 pounds (44kg) for each cubic yard of shotcrete. The steel fibers must be premixed with the cement.

24.4 **Acceptance Sampling and Testing**

24.4.1. **General:** Shotcrete test panels shall be prepared by the contractor on vertically supported molds. Test panels shall be approximately 24 inches by 24 inches (610mm x 610mm) by a minimum of 3 inches (76.2mm) deep. The material used to form the back and sides of the molds shall be rigid, nonabsorbent and be non-reactive with cement. The shotcrete placement in vertical molds shall be accomplished utilizing the same shotcrete mix, air and water pressure, and nozzle tip as used for the actual placement of shotcrete on production surfaces. The panels shall be left undisturbed and protected at the point of placement for at least 24 hours or until the final set has taken place. The shotcrete shall be applied to a thickness of 3 to 3.25 inches (76.2mm to 89mm),

with no sagging.

24.4.2 **Preproduction Testing:** The contractor shall prepare at least two test panels for each mix design for testing. The test panels shall be cured using the approved curing compound in a manner similar to the anticipated field conditions. The engineer shall receive a copy of the mix design and the compressive test results at least 5 days prior to starting any production work. Production shotcrete work shall not begin until satisfactory test results are obtained.

24.4.3. **Shotcrete Compressive Strength:** The shotcrete shall be capable of attaining 2500 psi compressive strength at 7 days (1800 psi at 3 days) and 4000 psi at 28 days as determined by AASHTO T 22 (ASTM C39-84) testing of compression test cylinders.

NOTE: Higher strength may be required and specified.

24.4.4. **Failure of Shotcrete:** Should any shotcrete section be deficient in any of the specified criteria, that section shall be remedied to the engineer's satisfaction at the contractor's expense. Such remedies may include, but not be limited to, removal and replacement of the substandard section.

24.5. **Equipment**

28.5.1. **Pump System:** The pump system used to convey premixed shotcrete ingredients shall deliver a uniform and uninterrupted flow of material without segregation or loss of the ingredients. The mixing equipment shall be capable of thoroughly mixing the specified materials in sufficient quantity to maintain continuous placing.

24.5.2. **Air Compressor:** The air compressor shall be capable of maintaining a supply of clean air adequate for maintaining sufficient nozzle velocity for all parts of the work and for the simultaneous operation of a blow pipe for clearing away rebound. The compressor shall be capable of providing a minimum of 250 cfm per operating nozzle.

24.5.3. **Dry-Mix Process**

24.5.3.1. **Batching and Mixing Equipment:** The mixing equipment shall be capable of thoroughly mixing the materials in sufficient quantity to maintain continuous application.

24.5.3.2 **Delivery Equipment:** The equipment shall be capable of discharging the aggregate-cement mixture into the delivery hose and delivering a continuous stream of uniformly mixed material to the discharge nozzle. The discharge nozzle shall be equipped with a manually operated water injection system (water ring) to direct an even distribution of water through the aggregate-cement mixture. The water valve shall be capable of ready adjustment to vary the quantity of water and shall be convenient to the nozzleman. The water pressure at the discharge nozzle shall be sufficiently greater than the operating air pressure to assure that the water is

thoroughly mixed with the other material. The water pressure shall be steady (nonpulsating). Equipment parts, especially the nozzle liner and water ring, shall be regularly inspected and replaced as required.

24.5.4. **Wet-Mix Process**

24.5.4.1. **Batching and mixing equipment:** The mixing equipment shall be capable of thoroughly mixing the specified materials in sufficient quantity to maintain continuous application.

24.5.4.2. **Delivery equipment:** The equipment shall be capable of discharging the premixed materials into the delivery hose and delivering a continuous stream of uniformly mixed material to the discharge nozzle. Recommendations of the equipment manufacturer shall be followed for the type and size of nozzle to be used and for cleaning, inspection, and maintenance of the equipment.

24.6. **Construction Requirements**

24.6.1. **Surface Preparation:** Immediately prior to shotcrete /rock fall netting application, rock surfaces of the areas to be shotcreted shall be scaled of all contaminating and loose material and be thoroughly cleaned by use of air or water jets, or other means approved by the engineer, in order to provide a suitable bonding surface (see Rockfall Netting Section of these Technical Specifications). Soil surfaces shall be cleaned of loose material by an air jet.

Shotcrete shall not be placed on any surface that is frozen, spongy, or where there is free water. The surface shall be dampened before applying shotcrete.

24.6.2. **Shotcrete Blanket Thickness Control:** The thickness of the shotcrete blanket shall be controlled by installing noncorrosive pins, nails, or other gauging devices normal to the face, such that they protrude the required shotcrete thickness outside the face. These pins shall be placed on a maximum 8-foot (2.4 meters)-square pattern. When rockfall netting reinforcement is used, a minimum 1-inch (25.4mm) cover of shotcrete shall be placed over the welded wire fabric.

The lower 2 feet (.61 meters) of the rock slope shall not be shotcreted to allow drainage.

24.6.3. **Weep Holes:** Unless otherwise shown on the plans, weep holes shall be provided throughout the shotcrete mat at 10-foot (31 meters) centers maximum, horizontal and vertical. The weep holes shall be in contact with open points in the natural rock. Prior to shotcreting, survey stakes shall be driven into open joints. Shotcrete shall be applied around the stakes. After the shotcrete has reached the initial set, the stakes shall be removed to leave the drain hole open.

24.7 Batching and Mixing Shotcrete

24.7.1. **Dry-mix Process:** The cement and aggregate shall be batched by weight. Predampening shall be carried out prior to flow into the main hopper and immediately after flow out of the packing in order to ensure that the premix will flow at a uniform rate (without slugs) through the main hopper, delivery hose and nozzle to form uniform shotcrete, free of dry pockets. No predampened cement/aggregate mix shall be used if allowed to stand for more than 90 minutes.

24.7.2. **Wet-Mix Process:** Batching and mixing shall be done according to the applicable provisions of ASTM C 94.

24.7.3. **Batching and Mixing Steel Fibers:** Steel fibers shall be premixed with the cement prior to batching shotcrete.

24.7.4. **Shotcrete Application:** Unless shown on other plans, the minimum thickness of shotcrete shall be 2 inches (50.8mm) and the maximum thickness shall be 3 inches (76.2mm) for steel fiber reinforced shotcrete. Where rockfall netting is used, the mesh shall be covered with a minimum of 1 inch (25.4mm) of shotcrete (3" total thickness approx.).

The shotcrete shall be applied from the lower portion of the area upward so that rebound does not accumulate on the portion of the surface that still has to be covered. Rebound material shall not be worked into the finished product. Rebound is defined as the shotcrete constituents that fail to adhere to the surface to which shotcrete is being applied. It shall not be salvaged and included in later batches. Shotcrete shall emerge from the nozzle in a steady uninterrupted flow. When, for any reason, the flow becomes intermittent, the nozzle shall be diverted from the work until steady flow resumes. A nozzleman's helper, equipped with an air blowout jet, shall attend the nozzleman at all times during the placement of shotcrete to keep the working area free from rebound.

Shooting shall be suspended if:

High winds prevent the nozzleman from proper application of the material.

The temperature is below 40°F (5°C).

External factors, such as rain or seepage, wash cement out of the freshly placed material or cause sloughs in the work.

Construction joints shall be tapered over a minimum distance of 12 inches (305mm) to a thin edge and the surface of such joints shall be thoroughly wetted before any adjacent section of mortar is placed. Square construction joints shall not be permitted.

The surface shall be sounded with a hammer for unsound areas resulting from rebound pockets or lack of bond. Areas, sags, or other defects shall be carefully cut out and replaced with a succeeding layer at the contractor's expense. When fabric reinforcement is used and is damaged or destroyed by such repairs, the damaged area shall be replaced by properly lapped and tied additional wire fabric.

Where a layer of shotcrete is to be covered by a succeeding layer, it shall first be allowed to take its initial set. The initial layer shall be cleaned of all loose material prior to placing succeeding layers.

24.7.5. **Finishing:** The shotcrete surface shall be left in the natural gun finish.

24.7.6. **Curing:** Placed shotcrete shall be cured by applying a white pigmented, liquid membrane-forming curing compound, as specified in the Standard Specifications. The curing compound shall be applied immediately after gunning. The air in contact with shotcrete surfaces shall be maintained at temperatures above freezing for a minimum of seven days. Curing compounds shall not be used on any surfaces against which additional shotcrete or other cementitious finishing materials are to be bonded unless positive measures, such as sandblasting, are taken to completely remove curing compounds prior to the application of such additional materials.

SECTION XXV

TECHNICAL SPECIFICATIONS

FLOWABLE FILL

25.1. SCOPE

This work shall consist of furnishing and installing controlled, low-strength concrete material (flowable fill) as indicated on the drawings or as directed by the Engineer. The work shall include required excavation, forming, labor and all other incidentals and appurtenances associated therewith.

Flowable fill may be used at the direction and discretion of the ENGINEER to backfill culverts in situations where compaction requirements for bedding have not been achieved. It can also be used at the contractor's discretion and at his own expense in lieu of typical culvert backfill, with approval of the ENGINEER.

25.2. MATERIALS

Flowable fill shall consist of controlled, low-strength, cement based concrete or "grout" as described in the current edition of the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction". Flowable fill shall be mixed to achieve a twenty-eight (28) day compressive strength between 1000 and 1200 psi. The following mixture portions shall be utilized with variations allowed by the ENGINEER depending on availability of materials locally:

<u>Cement</u>	<u>Fly Ash Type F</u>	<u>Sand (S.S.D.)</u>	<u>Water</u>
(lb/cu.yd)	(lb/cu.yd)	(lb/cu.yd)	(lb/cu.yd)
200-250	300	3000	400-450

25.3. INSTALLATION

Flowable fill shall be installed as directed by the ENGINEER and/or as specified in the drawings. **All pipes shall be anchored properly before fill is placed to prevent the pipes from moving from their required lines and grades. It shall be the responsibility of the Contractor to ensure that all pipes meet the lines and grades shown on the drawings or as directed by the Engineer**

SECTION XXVI

TECHNICAL SPECIFICATIONS

GEOGRID

26.1. SCOPE

The work shall consist of furnishing and installing a geogrid system and its components as indicated on the Drawings or as otherwise directed by the ENGINEER.

26.2. General

Biaxial geogrids are for base reinforcement for access roads and retaining walls. Uniaxial geogrids are to reinforce soil and backfill masses in retaining wall structures.

Flexible geogrid mesh (Biaxial Geogrid and Uniaxial Geogrid) shall be fabricated of polypropylene or polyester yarn encapsulated with protective coating and shall feature aperture configurations and sufficient cross sections at junctions and ribs to permit significant interlock with soil materials. The geogrid shall have high tensile modulus relative to the soil, high flexural rigidity, and high continuity of tensile strength through all junctions and ribs. The geogrid shall retain its reinforcement characteristics under repeated dynamic loads in service. The geogrid shall be resistant to ultra-violet radiation, chemical degradation and damage from normal construction practices.

26.2. MATERIALS

26.2.1. Biaxial Geogrid: The Biaxial geogrid shall have the following minimum strength characteristics as defined by ASTM-D-4759:

Manufacturer's Product	Dynamic Load Capacity True Tensile Strength at 2% Strain (lbs/ft)	
	Machine Direction	Cross Direction
	(MD)	(XD)
BX 1100 or Comparable	280	450
BX 1200 or Comparable	410	600
BX 1300 or Comparable	300	480
BX 1500 or Comparable	625	870
BX 4100 or Comparable	240	300
BX 4200 or Comparable	370	500

Manufacturer's Product	Dynamic Load Capacity True Tensile Strength at 5% Strain (lbs/ft)	
	Machine Direction	Cross Direction
	(MD)	(XD)
BX 1100 or Comparable	580	920
BX 1200 or Comparable	810	1340
BX 1300 or Comparable	680	1030
BX 1500 or Comparable	1100	1495
BX 4100 or Comparable	480	635
BX 4200 or Comparable	705	960

26.2.2. **Uniaxial Geogrid:** Uniaxial Geogrid shall have the following minimum strength characteristics as defined by ASTM-D-4759:

Manufacturer's Product	Dynamic Load Capacity True Tensile Strength at 2% Strain (lbs/ft)	
UX 1100 HS or Comparable	550	
UX 1400 HS or Comparable	1000	
UX 1500 HS or Comparable	1800	
UX 1600 HS Comparable	2330	
UX 1700 HS Comparable	2740	

Manufacturer's Product	Dynamic Load Capacity True Tensile Strength at 5% Strain (lbs/ft)	
UX 1100 HS or Comparable	1165	
UX 1400 HS or Comparable	2000	
UX 1500 HS or Comparable	3700	
UX 1600 HS or Comparable	4450	
UX 1700 HS or Comparable	5400	

26.2.3. **Welded Wire Forms:** Welded wire form facing units shall be pre-fabricated from #4 black wire 4.4 - 4.0 x W4.0 as "welded wire fabric". These units shall be formed 1.5' x 1.5' x 10' - 4" except as authorized in writing by the ENGINEER.

Adjacent forms shall be overlapped 2" and secured with #4 black wire or comparable strength metal fasteners.

Support struts shall be fabricated from #4 black wire at lengths specified by manufacturers' shop drawings, suitable for the wire forms. Struts shall be spaced at not less than 2' spacing.

26.2.5. **Certification:** Each shipment of geogrid and welded wire forms materials to the job site shall be accompanied by a certification from the manufacturer, which states that this material conforms to the requirements of this Specification. The certification shall be provided on the manufacturer's letterhead and shall be signed by an officer of that company.

26.3. **STORAGE AND HANDLING**

Geogrids shall be stored at temperatures greater than 20 degrees (F) and be shaded from periods of prolonged exposure to sunlight.

CONTRACTOR shall ensure that the geogrid mesh remains free of accumulations of mud, cement, debris, grease, and other contaminants.

26.4. **INSTALLATION**

26.4.1. **Site Preparation:** Excavation and backfill zones shall be free of trees, stumps, water concentrations, debris, boulders and other impediments which could adversely affect the installation of the geogrid. The surface should be graded as uniformly as practicable prior to deployment of the geogrid.

26.4.2. **Alignment and Orientation**

26.4.2.1. **General:** Geogrid re-enforcement shall be installed at the elevations, locations, and orientation as shown on the construction Drawings and as directed by the ENGINEER.

Manufactures guidelines shall be followed except as directed in writing by the ENGINEER.

26.4.2.2. **Biaxial Geogrid:** Each strip should be aligned parallel with the long axis of the main force. If joints are determined to be necessary the geogrids shall be overlapped a minimum of two feet.

26.4.2.3. **Uniaxial Geogrid:** The embedment length shall be ten feet and oriented the long axis perpendicular to the face of the wall. Joints will not require overlap of fabric. Each strip of uniaxial geogrid shall be continuous (without slice or overlaps).

26.4.2.4. **Welded Wire Forms:** This design specifies 18" x 18" wire forms to accommodate 18" backfill lifts. Forms shall be spliced end to end securely tied, and overlapped a minimum of two inches.

26.4.3. **Anchoring:** Geogrid shall be secured in place during construction using staples, pins, sand bags, or backfill as dictated by field conditions or as directed by the ENGINEER. It shall be secured as uniformly parallel to the prevailing in-place slope as practicable and shall be deployed fully, without kinks or wrinkles.

26.4.4. **Backfill:** Backfill material shall be placed in lifts and compacted so as to minimize displacing, wrinkling, or tearing the geogrid. The geogrid shall be covered in 18" lifts. Tracked equipment shall not operate directly on the geogrid with less than 6" of fill material and shall not be turned with less than 12" of fill material on the geogrid. Rubber-tired equipment may be operated on the geogrid at speeds less than 10 mph. Sudden braking and sharp turning shall be avoided.

SECTION XXVII

TECHNICAL SPECIFICATIONS

PILE AND LAGGING RETAINING WALL

27.1. **SCOPE**

This work shall consist of furnishing all materials, equipment, and labor necessary for installing Pile and Lagging Retaining Wall as shown on the Drawings or as directed by the ENGINEER. Efforts include drilling, installation of steel piles, and placement of concrete lagging, filter fabric, subdrain, and stone backfill.

27.2. **MATERIALS**

27.2.1. **Steel:** Steel shall be kept free from dirt, grease and other foreign matter, and shall be protected from corrosion.

27.2.1.1. **Steel Piles:** Piles shall be in accordance with the standard size designation shown on the Drawings. Steel piles shall conform to ASTM A36. Steel piles must be straight. Splicing of the steel piles to accommodate actual field conditions is permissible provided the splice is covered by concrete. The location of all splices must be pre-approved by the ENGINEER. All splicing shall be done in accordance with requirements specified in the AWS structural welding code and AWS D1.1, current edition with revisions. Any splicing performed shall be considered incidental to the cost of the pile.

27.2.1.1. **Steel Reinforcement:** All steel reinforcement shall be accurately placed in positions shown and firmly held in position during placement and hardening of concrete. Dimensions shown from the face of concrete to bars are clear distances, unless otherwise noted. Bar spacing are from center to center of bars. Bars shall be tied at all intersections.

Distances from forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports. Supports for holding reinforcement from contact with the forms shall be approved metal chairs. The steel placed in reinforced concrete shall be securely tied down to prevent any possibility of steel moving from the specified locations during placing, vibrating, and finishing the concrete. Metal supports shall have a shape that will be easily enveloped by the concrete.

All reinforcement shall be securely placed, inspected, and approved before the placing of concrete begins. Concrete placed in violation of this provision may be rejected.

Welding of rebar shall not be permitted. All bar reinforcement shall be Grade 60 and shall conform to ASTM A-615. Refer to the Reinforced Concrete Section of these Technical Specifications for the size of steel reinforcing bars.

27.2.2. **Concrete:** Concrete shall be Class AA concrete and conform to the Reinforced Concrete Section of these Technical Specifications.

27.2.3. **Precast Concrete Lagging:** Precast Concrete Lagging shall be the size indicated on the Drawings. Class AA concrete used in formation of the lagging shall have a compressive strength of 4,000 psi and shall conform to requirement of the Concrete Section of these Technical Specifications.

27.2.4. **Filter Fabric:** Conform to the Filter Fabric Section of these Technical Specifications.

27.2.5. **Drain Pipe:** Conform to the Drainage Pipe Section of these Technical Specifications

27.2.6. **Rock Backfill:** Conform to the Crushed Aggregate and Channel Lining Section of these Technical Specifications.

27.2. **GENERAL**

Material excavated during site preparation, wall construction, and final grading shall be utilized in a manner in accordance with the Earthwork Section of these Technical Specifications or as directed by the ENGINEER. Stockpiling of excavated material on the slope above the wall will not be permitted.

27.4. **CONSTRUCTION**

27.4.1. **Piles:** A hole, of the minimum diameter shown on the Drawings, will be pre-drilled to the minimum depth shown on the Drawings prior to installation of the piles. The piles are to be concreted completely from the bottom of the hole to within two (2) feet of the existing ground line, or as directed by the ENGINEER. Holes shall be pumped free of water prior to injection of grout. The concrete is to be pumped through a hollow pipe beginning at the bottom of the drilled hole. Concrete shall be placed in such a manner that it does not strike any obstruction such as the reinforcing steel or sides of the drill hole to avoid segregation of concrete. As concrete is injected, the hollow pipe shall be raised with care to ensure that its tip remains approximately two (2) feet below the surface of the concrete until the concrete reaches a point three to five (3-5) feet below the surface.

The CONTRACTOR will be required to complete all concrete placement operations for holes drilled during the working day.

27.4.2. **Casing:** **Permanent or temporary casing of holes shall be used as required by the Engineer to maintain an open clean hole through the soil overburden and to prevent holes with unstable sides from squeezing.** The diameter shall be as depicted and/or described in the drawings. Temporary casing or non-cased holes may be allowed provided an open

clean hole of a required diameter through the soil overburden can be maintained.

27.4.3. **Tolerances:** Piles shall be located as shown on the Drawings or as directed by the ENGINEER. Pile centers shall be installed within \pm 2-inches of the plan locations. Should the elevation of the bottom of the pre-drilled hole vary from the plan elevation more than \pm 1-foot, the ENGINEER must approve the installation of the pile and injection of grout prior to placement. To verify acceptable alignment, the CONTRACTOR shall utilize a plumb bob, carpenter level, or other acceptable methods. The maximum permissible deviation for the exposed section of piles from vertical alignment shall be based on aesthetical and structural aspects.

Records shall be maintained by the CONTRACTOR, and provided to the ENGINEER, which show the depth to which each pile is placed, the deviation from vertical plumb, the amount of materials used, and any unusual conditions encountered during the installation.

27.4.4. **Lagging:** Lagging shall be installed between adjacent piles such that each lagging member extends to within one inch of the pile web. Final grading at the front of the wall shall not proceed until lagging placement is complete.

27.4.5. **Filter Fabric:** The filter fabric shall be placed as shown on the Drawings and in accordance with the Filter Fabric Section of these Technical Specifications.

27.4.6. **Subdrain:** The Subdrain shall be installed as shown on the Drawings.

27.4.7. **Backfill:** Rock backfill shall be placed behind the wall to the lines and grades shown on the Drawings. If filter fabric is used, the CONTRACTOR will be required to limit the drop of rock backfill to no more than 3 feet. Backfill operations shall not commence until all lagging and filter fabric have been placed, and not until a test cylinder of the concrete has been successfully broken at 4,000 psi.

27.4.8. **Final Grading:** The rock backfill when indicated on the Drawings shall be covered with filter fabric and a layer of soil shall be placed over the exposed surface behind the wall if required by the Drawings. In all cases at least a 5' strip of rock must be left exposed behind the wall. Areas adjacent to the wall shall be shaped and finished to blend with the surroundings as directed by the ENGINEER.

SECTION XXVIII

TECHNICAL SPECIFICATIONS

DEBRIS BARRIER

28.1. SCOPE

This work will consist of constructing a wooden frame and stack of hay bales near the base of the slope as indicated on the Drawings or as directed by the ENGINEER. It also includes the complete removal of the wall when directed by the ENGINEER.

28.2. GENERAL

The exact locations, configuration, and dimensions of the debris barrier wall shall be directed by the ENGINEER at the time of construction. This structure shall be installed prior to any surface disturbance on the slope or in the lower reaches of the drain channel.

28.3. MATERIALS

28.3.1. Hay Bales: Either straw or hay bales may be used; typical of those described in the silt control section of these specifications under silt control. All bales are to be firmly bound by twine and securely fastened to the wood frame.

28.3.2. Wooden Post: All wooden post must consist of a single piece of treated wood and must be at least 4 inches by 4 inches square in cross section (nominal dimension) and 10 feet in height. This is typical of posts which are available at most lumberyards.

28.3.3. Plywood: All sections of plywood used in construction must be solid wooden sections at least 4 feet in width by 8 feet in height and at least $\frac{3}{4}$ inch in width. **Plywood shall be marine plywood** and typical of plywood pieces which are available at most lumberyards. Materials such as particleboard, chipboard etc. may not be substituted.

28.3. INSTALLATION & REMOVAL

The exact location of the debris barrier wall is subject to adjustments based on site conditions. Installation shall be as depicted in the drawings and as directed by the ENGINEER. Some hand labor may be required to ensure adequate footing and strength of the wall. Once the wall is no longer needed in the opinion of the ENGINEER, it shall be completely dismantled and all wooden materials and fasteners removed from the job site and disposed of properly.

28.4. MAINTENANCE

During the course of the project the debris barrier wall(s) shall be maintained in sound condition. In the opinion of the ENGINEER, any feature (i.e. wood members, fasteners, haybales, etc.) of this item that found to be compromised shall receive maintenance work as soon as practical. **Accumulation of materials (i.e. soil, silt, rock, etc.) behind the wall greater than two (2) feet shall be removed immediately.** These materials shall be transported and placed within a designated waste area as directed by the ENGINEER.

SECTION XXIX

TECHNICAL SPECIFICATIONS

DRAINAGE PIPE

29.1. **SCOPE**

This work shall consist of furnishing and installing drainage pipe at the locations shown on the drawings or as directed by the Engineer, including all necessary fittings and backfilling with appropriate materials in accordance with these technical Specifications

29.2. **MATERIALS**

29.2.1. **Corrugated Metal Pipe (CMP):** All corrugated metal pipe shall conform to the requirements of AASHTO M 36. Pipe shall have welded seams with helical corrugations having a pitch of 2-2/3 inches and a depth of 1/2 inch. The minimum metal thickness of the pipes shall be 14 gage for 24-inch diameter or less and 12 gage for 36-inch and greater diameter, unless fill heights dictate a different gage according to charts in the Kentucky Transportation's Standard Drawings Road roadway drainage section

29.2.1.1. **Connections:** The connections between sections of pipe and end treatments shall be made with coupling bands or other mechanisms of durability equal to or greater than the pipe. Coupling bands shall meet the requirements of AASHTO M 36.

29.2.1.2 **Coatings:** Any damage to the coating shall be repaired by thoroughly wire brushing the damaged area, removing all loose and cracked coating, removing all dirt and greasy material with solvent, and painting with two coats of material. If the coating is damaged in any individual area larger than 12 square inches, or if more than 0.2 percent of the total surface area of a length of pipe is damaged, the length will be rejected.

29.2.1.3. **Zinc Coating:** The repair coating shall be a zinc dust-zinc oxide primer or equivalent as specified by the manufacturer.

29.2.1.4. **Bituminous Coatings:** All BCCMP pipe shall be fully bituminous coated in accordance with AASHTO M 190. Breaks and scuffs in bituminous coatings that are less than 36 square inches in area shall be repaired by the application of two (2) coats of hot asphaltic paint or a coating of cold applied bituminous mastic. The repair coating shall be at least 0.05 inches thick after hardening and bonded securely and permanently to the pipe. The material shall meet the physical requirements for bituminous coatings contained in these Technical Specifications. Whenever individual breaks exceed 36 square inches of area or when the total area of breaks exceed 0.5 percent of the total surface area of the

pipe, whichever is less, the pipe will be rejected.

29.2.2 **Reinforced Concrete Pipe (RCP)**: The drainage pipe shall be Class III RDP conforming to the requirements of the Kentucky Transportation's "Standard Specifications for Road and Bridge Construction", current edition pertaining to RCP unless Fill heights dictate a different class according to the charts in the Kentucky Transportation's Standard Drawings roadway drainage section. The pipe can be circular or non-circular and the length as indicated on the Drawings or as directed by the Engineer

29.2.3 **High Density Polyethylene Pipe (HDPE)**: The drainage pipe shall be made of virgin high density polyethylene compounds which conform to the requirements of Type III, Category 4, 5, Grade P30 or P34 Class C per ASTM D128. HDPE and pipe shapes shall meet the requirements of ASTM F405, ASTM F667 AASHTO M294-851; ASTM D2122 with minimum 20-foot lengths.

29.2.3.1. **Connections**: Corrugated Fittings may be either molded or fabricated by the manufacture. The use of fittings supplied by the manufactures other than the supplier of the pipe shall not be permitted without the approval of the Engineer.

Couplings shall be corrugated to match the pipe corrugations and the width shall not be less than half the nominal diameter of the pipe, Split couplings shall be manufactured to engage an equal number of corrugations on each side of the pipe joint. Where required by Engineer, a mastic type gasket or other gasket acceptable to the Engineer may be used.

29.2.4. **Backfill**: Backfill around all **Drainage Pipe** installations shall consist of No. 57 crushed stone or **Flowable Fill** as shown on the Drawings and in accordance with these Technical Specifications.

29.2. **CONSTRUCTION**

In all operations, such as placing the pipe, jointing, bedding and backfilling, care shall be exercised. It shall be the CONTRACTOR'S responsibility to see that pipes are not damaged during unloading or placement, during compaction of the backfill by movement of excessively heavy equipment over the backfill, or by any other forces that may cause damage.

Trenches for pipes shall be excavated to the lines and grades shown on the Drawings. The trench shall be dry and unfrozen at the time the pipe is installed. Soft and/or hard spots shall be made as uniform as practical with sand, gravel, crushed stone, or other suitable material to ensure even settlement of the pipe. Backfill shall be placed in layers not exceeding 6 inches loose thickness for hand operated machine compactors and 8 inches loose thickness for other compaction methods, unless otherwise specified. Fill material shall be free from organic material, stumps, large rocks, hard lumps, or clods larger than 3 inches in diameter. Sod,

cinders, and frozen fill will not be allowed. The pipe shall be laid so outside laps of circumferential joints point upstream, with no longitudinal joints in the lower quadrant. Bedding shall be of the type and thickness shown on the Drawings. Maximum stone size shall not exceed 3/4 inch or the maximum size recommended by the pipe manufacturer, whichever is smaller. Hand tampers for compacting horizontal layers should weigh not less than 20 pounds and have a maximum face of 6 inches x 6 inches. Sheepsfoot and rubber-tired tamping rollers can be used to compact backfill around the pipe **provided they will not cause damage to the pipe**. Power tampers and rollers must not contact the pipe. Fill adjacent to the pipe must be hand or mechanically tamped. The backfill shall be brought up evenly on both sides of pipe for the full length of the pipe. The remainder of the trench, except for special materials for roadways, shall be backfilled with satisfactory material. Special materials for roadways shall be used as designated on the Drawings or provided in writing by the ENGINEER. A pipe that is found not to be in true alignment, or which shows abnormal settlement after placement, shall be removed and reinstalled as directed by the ENGINEER.

Where flowable fill is used the Contractor shall take extra care to anchor the pipe, especially HDPE pipe, in accordance with these Technical Specifications. Failure to properly anchor pipes where they are in not proper alignment or grade in accordance with the Drawings shall result in the Contractor removing the pipe and relaying the pipe to the proper alignment and grade.

All pipe placed without the use of a headwall or any type of anchor shall be flush with the slope, where the water flowing out of the pipe will not create a condition that will cause the pipe to be undercut.

Installation of the pipe (including excavation, backfill, and temporary traffic base) shall be completed in one day; and coordinated beforehand with local residents. All necessary arrangements are the responsibility of the CONTRACTOR, subject to the ENGINEER'S approval. **The Drawings may specify that the construction not interrupt the flow of traffic. In that case the Contractor must submit a plan to keep traffic flowing while constructing the pipe crossing and will be subject to the approval of the Engineer.**

SECTION XXX

TECHNICAL SPECIFICATIONS

PNEUMATIC BACKSTOWING

30.1. SCOPE

The work shall consist of filling openings and voids with select graded aggregates utilizing a **pneumatic** backstowing process only.

30.2. MATERIALS

30.2.1. **Granular Fill:** Granular fill shall be size No. 57 or No. 8 coarse aggregate and conform to the Crushed Aggregate and Channel Lining section.

30.2. CONSTRUCTION

Work shall consist of granular fill pneumatically stowed in the designated features such as, but not limited to, portal closures and mountain breaks. Debris, rubble, and other loose material shall be removed from these areas prior to backfilling efforts. All material except soil and rock (e.g. domestic debris) shall be disposed of in a suitable manner as approved by the ENGINEER.

SECTION XXXI

TECHNICAL SPECIFICATIONS

POLYURETHANE FOAM

31.1. SCOPE

This work shall consist of furnishing and installing all materials necessary to construct seals using polyurethane foam as depicted in the Drawings and as directed by the ENGINEER.

31.2. MATERIALS

31.2.1. POLYURETHANE FOAM (PUF): The material specifications for PUF (sometimes described as Equipment less Foam Sealant) are based on products manufactured by FOAM CONCEPTS, Inc., 604 West 41st Street, Hibbing, MN 55746(888-744-7584). Technical support was provided by Progressive Marketing Group, P.O. Box 860, 1906 Highway 71 North, Okaboji, IA 51355, (800-373-2593).

Comparable foam products from other sources are acceptable provided they meet the defined standards and characteristics stated herein as verified by a written statement from the manufacturer.

PUF characteristics shall conform to the standards indicated below:
PUF CHARACTERISTICS SPECIFIED IN

Density (PCF)	2.00 or greater	ASTMD-1622
Closed Cell Content (%)	80 or greater	ASTMD-2856
Parallel Compressive Strength (PSI)	22 or greater	ASTMD-1621
Perpendicular Compressive Strength (PSI)	10 or greater	ASTMD-1621
Shear Strength (PSI)	28 or greater	ASTMC-273
Water Absorption (PSF)	0.01 or greater	ASTMD-2842-69
Immersion	Coast Guard Tests	ASTM
Tensile Adhesion (PSI)	20 or greater	ASTMD-1623
K-Factor (BTU in hr. ft. 2°F)	0.140 or greater	ASTMD-518
Buoyancy Losses	.3 or greater	ASTMD-2842-69
Percent Volume Change (% humidity)		
Humid Days (95%)	-2.0 or greater	
Dry Days	+1.0 or greater	

These products roughly exhibit the following characteristics when mixed between 30° and 90° Fahrenheit:

Initiation of Rise (Sec)	20 - 30
Gel Time (Sec.)	130 - 160
Tack Free Time (Sec.)	190 - 240
Core Density (PCF)	2.3 - 2.6

31.3. **CONSTRUCTION METHODS**

31.3.1. **General:** Foam closures and seals shall be constructed in accordance with manufacturer's recommendations regarding the use of the foam materials. Construction of bulkheads and protective covers shall be conducted in accordance with commonly accepted construction practices. Reasonable alternatives to the guidelines provided on the drawings shall be allowed if approved by the ENGINEER.

The CONTRACTOR may be required to reinforce the foam construction with pieces of steel rebar, wire mesh, or broken concrete embedded within the foam. Native stone, earth, concrete, grout, and aggregates may be required for forming efforts as needed. Bulkheads shall be constructed from similar materials and common construction materials such as wood, plastic, sheet metal, tin and fibrous materials. Any flammable materials used in the outer bulkheads shall be removed after the foam hardens and before required cover material placement.

Foam must be applied in layers allowing each successive layer to expand, cool, and harden before the next layer can be applied. PUF shall not be applied to foam that is currently expanding. PUF shall be applied in such a manner as to fill the voids in the portal and not create pockets inside the foam plug and shall form a solid wall around pipes at the outer barrier.

The entire surface of the foam plug shall be backfilled with two (2) feet (min.) of earth materials/aggregate or one (1) foot (min.) of concrete grout combined with cobbles or boulders. Backfill shall form a fire resistant ultra-violet proof cover for the foam plug.

31.3.2. **Safety:** Workers shall be required to wear organic respirator masks, safety glasses or goggles, body covering such as coveralls, and gloves while working with foam materials.

SECTION XXXII

TECHNICAL SPECIFICATIONS

RAILROAD RAIL STEEL RETAINING WALL

32.1. **SCOPE**

This work shall consist of furnishing all materials, equipment, and labor necessary for constructing the railroad rail steel retaining wall as shown on the Drawings or as directed by the ENGINEER. This effort includes drilling holes of required diameter, installation of rail steel piles, grouting piles in place, backfilling wall with aggregate and attaching steel panels.

32.2. **MATERIALS**

32.2.1. **Rail Steel:** Rail steel pile sections shall be in accordance with the standard size designation shown on the Drawings.

Rail steel shall be kept free from dirt, grease, and other foreign matter, and shall be protected from corrosion. Steel piles must be straight. Splicing of steel piles will not be permitted without permission of the ENGINEER. When authorized, all splicing shall be done in accordance with requirements specified in the AWS structural welding code and AWS D1.1 current edition with revisions.

32.2.2. **Grout:** Grout shall consist of a mixture of Portland cement, fine aggregate, and water. Portland cement shall be Type II conforming to ASTM C 150. Fine aggregate shall consist of inert natural sand conforming to ASTM C 33 or C 404. Water shall be clear, fresh, and free from injurious amounts of oil, acid, organic matter, or other deleterious substances. Maximum net water content per bag of cement shall be 6 gallons. The materials shall be proportioned to provide a minimum 28-day compressive strength of 3,000 psi.

32.2.3. **Steel Panels:** The steel panels, where specified in the drawings, shall be eleven (11) gauge corrugated galvanized steel panels as shown on the Drawings. Corrugations shall be approximately 1 inch. All panels shall be newly manufactured. Panels shall be free from dirt, grease, and other foreign matter and shall receive two coats of flat black rust preventative polymer paint.

32.3. **GENERAL**

Material excavated during site preparation, wall construction, and final grading shall be utilized in a manner as directed by the ENGINEER. Stockpiling of excavated material on the slope above the wall will not be permitted.

32.4. **CONSTRUCTION METHODS**

32.4.1. **Rail Steel Piles:** A hole, of the minimum diameter shown on the Drawings, will be pre-drilled to the minimum depth shown on the Drawings prior to installation of the piles. Temporary casing of holes shall be used if needed to maintain an open, clean hole through the soil overburden. The cost of any casing utilized shall be incidental to pile installation. If the test boring shows rock at a different depth than assumed in the Drawings, the design shall be adjusted in accordance with the rail guidance exhibits found in the drawings and these Technical Specifications.

The piles are to be grouted completely from the bottom of the hole to within two (2) feet of the existing ground line, or as directed by the ENGINEER. Holes shall be pumped free of water prior to injection of grout. The grout is to be pumped through a hollow pipe beginning at the bottom of the drilled hole. As grout is injected, the hollow pipe shall be raised with care to ensure that its tip remains approximately two (2) feet below the surface of the grout until the grout reaches a point three to five (3-5) feet below the surface.

The CONTRACTOR will be required to complete all grouting operations for holes drilled during the working day.

32.4.2. **Steel Panels:** The steel panels shall be welded or strapped to the rail steel. All welding shall be performed by a licensed welder or certified welder. The steel panels shall be welded at the top, middle, and bottom and shall be overlapped three (3) inches vertically and six (6) inches horizontally. The ENGINEER may change the overlaps if he deems necessary.

32.4.3. **Tolerances:** Piles shall be located as shown on the Drawings or as directed by the ENGINEER. Pile centers shall be installed within ± 2 -inches of the plan locations. Should the elevation of the bottom of the pre-drilled hole vary from the plan elevation more than ± 1 -foot, the ENGINEER must approve the installation of the pile and injection of grout prior to placement. To verify acceptable alignment, the CONTRACTOR shall utilize a plumb bob, carpenter level, or other acceptable methods. The maximum permissible deviation for the exposed section of piles from vertical alignment shall be based on aesthetical and structural aspects.

Records shall be maintained by the CONTRACTOR, and provided to the ENGINEER, which show the depth to which each pile is placed, the deviation from vertical plumb, the amount of materials used, and any unusual conditions encountered during the installation.

SECTION XXXIII

TECHNICAL SPECIFICATIONS

CONCRETE

33.1 SCOPE

This work covers the furnishing of all materials and equipment, and performing all operations specified herein, including the manufacturing, transporting, placing, finishing, and curing of the reinforced concrete.

33.2 GENERAL

33.2.1. **Workmanship:** All concrete work which does not conform to the specified requirements, including strength tolerances and finishing, shall be corrected as directed by the ENGINEER at the CONTRACTOR'S expense and without extension of time therefore.

33.2.2. **Codes and Standards:** Comply with the provisions of the following codes, specifications and standards, latest editions, except as otherwise modified herein:

- (1) Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition.
- (2) American Society for Testing and Materials, ASTM.
- (3) American Concrete Institute, ACI 311 "Recommended Practice for Concrete Inspection".
- (4) American Concrete Institute, ACI 347 "Recommended Practice for Concrete Formwork".
- (5) American Concrete Institute, ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures".
- (6) Concrete Reinforcing Steel Institute, "Manual of Standard Practice".
- (7) American Welding Society, AWS DR.1 "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connectors in Reinforced Concrete Construction".

33.3 **CLASSIFICATION**

Concrete shall be classified as follows:

CLASSES OF CONCRETE							
Class of Concrete	Approximate % Fine to Total Aggregate		Maximum Free Water by W/C Ratio	28-day Compressive Strength	Slump	Minimum Cement Factor	Air Content
	Gravel	Stone	lb/lb	psi	inches	lb/cy	%
A	36	40	0.49	3,500	2-4	564	6+2
A Mod	36	40	0.47	3,500	4-7	658	6+2
AA	36	40	0.42	4,000	2-4	620	6+2
B	40	44	0.66	2,500	3-7	451	6+2
D	35	39	0.44	4,000	3-5	639	6+2
D Mod	35	39	0.42	5,000	3-5	733	6+2
CLASSES & PRIMARY USES							
Class A. All headwalls, non bearing structures & all structures where class is not specified.							
Class A Modified. All Concrete deposited under water.							
Class AA. All retaining walls and load bearing structures.							
Class B. All Gravity retaining walls and non-reinforced concrete deposited as fill.							
Class D & D Modified. All Precast and prestressed piles or beams							

33.4. **MATERIALS**

Concrete shall be Portland cement, water, fine aggregate, coarse aggregate, and when specified or approved in writing by the ENGINEER, admixtures for entraining air or retarding agents. The design of the concrete mixture shall be based on the water-cement ratio necessary to secure (a) a plastic workable mixture suitable for the specific conditions of placement, and (b) when properly cured, a product having durability, impermeability and strength in accordance with all the requirements of the structures covered by these specifications.

The consistency of any concrete shall be such that it can be worked readily into the corners and angles of the forms and around reinforcement with the method of placing employed, but without permitting the materials to segregate or excess free water to collect on the surface. The slump range shown in subsection 19.3 represents the extreme limits of allowable slump when tested, in accordance with ASTM Designation C 143.

Where vibrators are used, the ENGINEER may allow a slightly less slump than the specified minimum.

The quantity of mixing water shall not be changed without the consent of the ENGINEER.

33.4.1. Cement

33.4.1.1. Portland Cement: Portland cement shall meet the requirements of ASTM C 150 for Type I cement, unless otherwise directed by the ENGINEER.

33.4.1.2. Air-Entraining Portland Cement: Air entraining Portland cement shall meet the requirements of ASTM C 175 for the type of cement specified.

33.4.1.3. Sampling and Testing: Portland cement shall be subject to sampling and testing in accordance with ASTM C 150.

33.4.2. Aggregates

33.4.2.1. Fine Aggregate: Fine aggregate shall be sand having clean, hard, durable, well graded particles and free from deleterious substances and shall conform to the provisions of ASTM C 33 and C 136.

33.4.2.2. Coarse Aggregate: Coarse aggregate shall be crushed limestone of hard, clean, durable particles free from deleterious substances and shall conform to the provisions of ASTM C 33 and C 136. Size No. 57 shall be used throughout.

33.4.3. Water

Water used in mixing concrete shall be fresh, clean and free from injurious amounts of sewage, oil, acid, alkali, salts, or organic matter, and its source shall be subject to the approval of the ENGINEER.

33.4.4. Admixtures

33.4.4.1. Air-Entrainment: The air-entraining admixtures shall fully meet the requirements of ASTM Designation C 260 and shall be subject to tests in accordance with ASTM C 233.

33.4.4.2. Retarding Agents: Approved types of retarding agents shall be included in the concrete mix only when specified on the Drawings or authorized by the ENGINEER.

33.4.4.3. Other Compounds: The use of calcium chloride or other accelerators or anti-freeze compounds will not be allowed.

33.4.5. Steel Reinforcement

33.4.5.1 **Reinforcing Bars:** Steel reinforcement shall be deformed type bars conforming to ASTM A 615. Reinforcement shall be manufactured from new billet steel of American manufacturer, and shall conform to Grade 60, yield strength 60,000 psi minimum

ASTM STANDARD REINFORCING BARS				
Bar Size English and (Metric)	Nominal Mass pounds per foot	Nominal Dimension-Round Sections		
		Diameter in inches	Cross Section Area, sq, inches	Perimeter inches
#3 (10)	0.376	0.3750	0.11	1.178
#4 (13)	0.668	0.5000	0.20	1.571
#5 (16)	1.043	0.6250	0.31	1.963
#6 (19)	1.502	0.7500	0.44	2.356
#7 (22)	2.044	0.8750	0.60	2.749
#8 (25)	2.670	1.0000	0.79	3.142
#9 (29)	3.400	1.1280	1.00	3.544
#10 (32)	4.303	1.2700	1.27	3.990
#11 (36)	5.313	1.4100	1.56	4.430
#14 (43)	7.650	1.6930	2.25	5.320
#18 (57)	13.600	2.2570	4.00	7.090

33.4.5.2. **Accessories:** All chairs and bolsters for use in exposed concrete shall have plastic covered tips or galvanized steel legs.

33.4.5.3. **Shop Fabrication:** Reinforcing steel shall be fabricated to shapes and dimensions indicated on the Drawings and in compliance with applicable provisions of ACI 315 and ACI 310. Bars shall be bent cold. Bars shall be prefabricated to detail and delivered to the job plainly tagged and ready to set.

33.4.5.4. **Field Fabrication:** Any field fabrication of reinforcing steel shall comply with requirements of shop fabrication specified in these Technical Specifications.

33.4.5.5. **Mill Tests:** Mill tests of reinforcement shall be submitted prior to use for each 15 tons, or less, shipped to the job site. Tests shall be conducted in conformance with ASTM A 615.

33.4.6. **Fiber:** Where fiber reinforced concrete is to be used as called for in the Drawings or as directed by the Engineer it shall meet the requirements as set forth in ASTM C 1116.

Unless otherwise specified the fiber will be added at the rate of 3.0 pounds per cubic yard. The fiber can be added at anytime

following the initial mixing of aggregate, cement and water. An extra 3-4 minutes shall be added to ensure that the fiber has been thoroughly distributed.

Fiber shall be used to reduce concrete cracking, as an alternate system of nonstructural secondary and/or temperature reinforcement, internal support and cohesiveness, lower permeability of concrete. Placements where nonmetallic materials are required and areas requiring materials that are both alkali and chemical resistant.

The fiber shall not be used as a substitute for steel reinforcement where structures are concerned. The fiber can be used in conjunction with steel reinforcement as a secondary reinforcement but not as a replacement for the required steel reinforcement as designed.

33.5. **AIR-ENTRAINED CONCRETE**

33.5.1. **General:** Unless otherwise noted, all concrete shall be air-entrained. Air-entrainment shall be accomplished by using an air-entrained Portland cement or by using an air-entraining admixture with normal Portland cement. If the entrained air content falls below the specified limit when using air-entrained cement, an air-entraining admixture shall be used in sufficient quantity to bring the entrained air content within the specified limits. If the entrained air content is found to be greater than the maximum specified when using an air-entrained cement, the use of air-entraining cement shall be prohibited; and air-entrainment shall be accomplished by using an air-entraining admixture with normal Portland cement. Air-entraining admixtures shall be added in solutions to a portion of the mixing water by means of a mechanical batcher in a manner that will ensure uniform distribution of the agent throughout the batch. Air entraining agents shall comply with ASTM C 260.

The air content of freshly mixed air-entrained concrete shall not be less than 4 or more than 6 percent of the volume of the concrete when determined by the methods specified in ASTM C 138, C 173, or C 231. The air content shall be checked during the period of time that the required test cylinders are being cast.

33.5.2. **Adjustment of Mix Proportions:** When air-entrained concrete is specified, the amount of water and fine aggregate prescribed for normal concrete shall be reduced to compensate for the increased volume of air contained in the air-entrained concrete.

33.6. **PROPORTIONING AND DESIGN OF MIXES**

The CONTRACTOR shall be responsible for design mixes for each type of concrete shown and/or specified. He shall use an independent testing facility accepted by the ENGINEER for preparing and reporting proposed mix designs.

Design mixes shall be proportioned by weight for each class of concrete required, complying with ACI 613 "Recommended Practice for Selecting Proportions for Concrete", and the following data reported:

- (1) Complete identification of aggregate source of supply.
- (2) Tests of aggregates for compliance with specified requirements.
- (3) Scale weight of each aggregate.
- (4) Absorbed water in each aggregate.
- (5) Brand, type, and composition of cement.
- (6) Brand, type, and amount of each component.
- (7) Amounts of water used in trial mixes.
- (8) Proportions of each material per cubic yard.
- (9) Gross weight and yield per cubic yard of trial mixtures.
- (10) Measured slump.
- (11) Measured air content.
- (12) Compressive strength developed at 7 days and 28 days, from not less than 3 test cylinders cast for each 7-day and 28-day test, and for each design mix.

The CONTRACTOR shall submit written reports to the ENGINEER of each design mix for each type and class of concrete, at least 7 calendar days prior to the start of the specified work. Include in each report the project identification name and number, date of report, name of contractor, name of concrete testing service, concrete class, source of concrete aggregates, manufacturer and brand name of manufactured materials, the precise proportions of the concrete mix, the properties specified herein for the type and class of concrete, and the test results for each property specified for the design mix.

The concrete mixes shall be designed so that the compressive strength of laboratory-cured cylinders, for each required strength, will be at least 15 percent greater than the minimum specified compressive strength; and so that not more than one test, of any 10 consecutive tests for strength, will have a value less than 90 percent of the required strength.

The criteria specified herein are maximums or minimums, and shall not be construed to predetermine fixed quantities of materials in the mix design, or to preclude change of an accepted mix design at any time. Mix design adjustments may be requested by the

CONTRACTOR when characteristics of materials, job conditions, weather, test results, or the circumstances warrant; at no additional cost to the COMMONWEALTH and as accepted by the ENGINEER. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by the ENGINEER before being used in the work.

33.7. **CONCRETE SAMPLING AND TESTING**

Standard tests of the materials and concrete may be made by the ENGINEER at any time he elects to do so. The testing service shall be selected by the COMMONWEALTH and paid by the COMMONWEALTH. Materials and installed work may require testing and retesting as directed by the ENGINEER at any time during the progress of the work. The ENGINEER shall be allowed free access to material stockpiles and facilities at all times. Tests, not specifically indicated to be done at the COMMONWEALTH'S expense, including the retesting of rejected materials and installed work, shall be done at the CONTRACTOR'S expense.

Concrete shall be sampled and tested for quality control during the placement of concrete as follows:

- (1) **Sampling Fresh Concrete:** ASTM C 172, except modified for slump to comply with ASTM C 94.
- (2) **Slump:** ASTM C 143; one test for each set of compressive strength test specimens.
- (3) **Air Content:** ASTM C 231, pressure method; one for each set of compressive strength test specimens.
- (4) **Compression Test Specimens:** ASTM C 31; one set of (4) standard cylinders for each compressive strength test.
- (5) **Concrete Temperature:** Test hourly when air temperature is 40°F and below, or when 80°F and above; and each time a set of compression test specimens are made.
- (6) **Compressive Strength Tests:** ASTM C 39; one set for each 50 cubic yards or fraction thereof, of each concrete class placed in any one day or in each separate feature of the project. One specimen will be tested at 7 days, one specimen will be tested at 28 days, and two specimens will be retained in reserve for later testing if required.
- (7) **Steel Reinforcement:** Testing for steel reinforcement shall meet the requirements ASTM A 615 or KYTC Kentucky Method 64-101-06.

Test of a portion of a batch may be made on samples representative of that portion for any of the following purposes:

- (1) Determining uniformity of the batch.
- (2) Checking compliance with requirements for slump and air content when the batch is discharged over an extended period of time.
- (3) Checking compliance of the concrete with the specifications when the whole amount being placed in a small structure, or a distinct portion of a large structure, is less than a full batch.

Test results shall be reported in writing to the COMMONWEALTH, ENGINEER, and CONTRACTOR on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of contractor, name of concrete supplier and truck number, name of concrete testing service, concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days; compressive breaking strength for both 7-day tests and 28-day tests.

The testing service shall take core samples of in-place concrete when test results are such that there is reasonable doubt that the specified concrete strengths and other characteristics have not been attained in the structure. The testing service shall conduct tests to determine the strength and other characteristics of the in-place concrete by compression tests on cored cylinders complying with ASTM C 42, or by load as outlined in ACI 318, or by other methods as directed.

The CONTRACTOR shall provide stable, insulated storage boxes, equipped with thermostatically controlled heat or an approved alternate facility for the storage of compression test cylinders in the first 24 hours after molding.

33.8. FAILURE TO MEET STRENGTH REQUIREMENTS

In the event that concrete tested in accordance with the requirements of these Technical Specifications fails to meet the specified strength requirements, the CONTRACTOR may be required to remove such concrete from the structure and replace such sections in a manner satisfactory to the ENGINEER. The cost of the removal and replacing such sections of concrete shall be borne by the CONTRACTOR.

When it is determined that such concrete shall be removed and replaced, the CONTRACTOR shall be notified in writing, stating the extent of the replacement to be made. Neither additional compensation nor time extensions will be granted for such work.

33.9. **BATCHING AND MIXING**

33.9.1. **Equipment:** Ready-mix concrete may be used. Measurements of materials for ready-mixed concrete shall conform to ASTM C 94. The ENGINEER shall have free access to the mixing plant at all times. Truck mixers will be allowed provided the use of this method will cause no violation of any applicable provisions of specifications for concrete contained herein. Truck mixers, unless otherwise authorized by the ENGINEER, shall be of the revolving drum-type, watertight, and so constructed that the concrete can be mixed to ensure the uniform distribution of materials throughout the mass.

Each truck mixer shall be equipped with a tank of known capacity, which shall be equipped with an accurate device for measuring the amount of water added. Truck mixers and agitators shall be operated within the limits of capacity and speed of rotation designated by the manufacturer of the equipment.

33.9.2. **Mixing Time:** Neither the speed nor the volume capacity of the mixer shall exceed those recommended by the manufacturer. Excessive over mixing, requiring additions of water to preserve the required consistency will not be permitted. The mixing time for each batch, after all solid materials are in the mixer drum, provided that all the mixing water shall be introduced before one-fourth (1/4) of the mixing time has elapsed, shall be not less than 1-1/2 minutes for mixers having capacities up to two (2) cubic yards. For mixers of larger capacities, this minimum shall be increased fifteen (15) seconds for each cubic yard or fraction thereof of additional capacity. When a truck mixer is used, each batch of concrete shall be mixed not less than fifty (50) nor more than one hundred (100) revolutions, at a mixing speed of not less than four (4) r.p.m. after all materials are in the mixer drum.

After adding all water, cement and aggregates to the mixer deliver and place concrete in its final position within the time limits of the following table. Do not use concrete that has developed initial set, that has become segregated or that has not been delivered within the time limits listed.

TIME OF DISCHARGE LIMITS					
(minutes)					
Normal Concrete			Retarded Concrete		
Agitated	Agitor	Non-Agitated	Agitated	Agitor	Non Agitated
60	45	30	90	60	30
All times begin when cement enters the mixer Normal concrete is concrete without additional of water-reducing admixture. Retarded Concrete is concrete to which an admixture has been added Agitated Concrete is concrete that has been continuously agitated until placed.					

33.9.3. **Conveying:** Concrete shall be conveyed from mixer to forms as rapidly as practicable, by methods which will prevent segregation, loss of ingredients, or displacement of reinforcement.

There shall be no vertical drop greater than five (5) feet, except where suitable equipment is provided, to prevent segregation and where specifically authorized by the ENGINEER.

The use of long chutes, troughs, belts, and pipes for conveying concrete from the mixing plant or point of delivery to the forms will be allowed only upon written permission. When such conveyors are allowed and the quality of concrete or methods of placing or working it therein are not satisfactory, the CONTRACTOR shall discontinue their use and re-equip his plant so that concrete will be placed in a satisfactory manner. Troughs, pipes, or chutes used as aids in placing concrete shall be arranged and used in such a manner that ingredients of the concrete are not separated. Where steep slopes are required, the chutes shall be equipped with baffle boards or be in short lengths that change the direction of movement. All chutes, troughs, and pipes shall be maintained clean and free from coating of hardened concrete by thoroughly flushing with water after each run or when out of operation for more than 30 minutes. Water used for flushing shall be discharged clear of concrete in place. The troughs, pipes, and chutes shall be either of metal or metal lined and shall extend as near as possible to the point of deposit. Aluminum or aluminum alloy troughs, pipes, or chutes will not be permitted.

Where wall forms exceed five (5) feet in height, suitable measures, such as the use of tremie tubes, where practicable, or portholes, shall be provided in the forms to limit the vertical drop of the concrete to a maximum of five (5) feet. Openings shall be spaced around the perimeter of the formed area so that lateral flow of fresh concrete will be limited to three (3) feet. Drop chutes, which may be provided to convey the concrete through wall ports, shall have an outside pocket under each form opening to stop the concrete and allow it to flow easily over into the form without separation.

No concrete shall be placed until the ENGINEER has given his approval of the subgrade, forms, and reinforcing steel in place. If the reinforcing steel is not placed in accordance with the Drawings, the ENGINEER shall stop the CONTRACTOR from placing any concrete until the error is corrected. Under no circumstances shall an attempt be made to correct errors by inserting additional unscheduled bars. No concrete shall be placed except in the presence of the ENGINEER, and the CONTRACTOR shall give reasonable notice of his intention to place.

Before any concrete is placed, the forms and subgrade shall be free of chips, dirt, sawdust, or other extraneous materials.

33.10. PLACEMENT OF STEEL

33.10.1 **Storage:** Reinforcing steel delivered to the job, and not immediately placed in forms shall be protected from mud and excessive rust producing conditions.

33.10.2. **Placement:** Metal reinforcement shall be accurately placed in accordance with the plans and shall be adequately secured in position with not less than 16-gage annealed wire or suitable clips at intersections. Reinforcement shall be held securely the required distance from the forms by concrete or metal chairs and spacers, except that broken brick or tile may be used to support reinforcement in footings on ground. Nails shall not be driven into outside forms to support reinforcement.

Space metal chairs, spacers, and hangers shall be in accordance with ACI 315 and ACI 318.

Metal reinforcement, at the time concrete is placed, shall be free from rust scale or other coatings that will destroy or reduce bond. Bars with kinks or bends not shown on the plans shall not be used. A thin coating of firmly attached rust shall not be cause for rejection.

33.10.3. **Splicing:** Splicing of reinforcement not shown on Drawings, or as specified in this paragraph, shall not be done except in specific instances previously approved by the ENGINEER. Splices shall not be made at point of maximum stress and shall provide sufficient lap to transfer stress by bond. Temperature bars in walls and floor slabs may be spliced by lapping 24 diameters. When splicing, the bars shall be overlapped a minimum of 18" and a maximum of 24" unless otherwise directed by the Engineer.

33.10.4. **Inspection:** The ENGINEER or his representative shall have 24 hours notice and the opportunity to inspect and pass upon the placement of reinforcing steel before concrete is placed, as follows:

- (1) For non-typical conditions Each condition
- (2) For typical conditions Each major placement

Such inspection shall be in the nature of assisting the CONTRACTOR to minimize errors, and in no case will they relieve the CONTRACTOR of his responsibility to provide the materials and workmanship required by the CONTRACT DOCUMENTS.

33.11. PLACEMENT OF CONCRETE

33.11.1. **General:** Concrete shall be placed In accordance with the "Times of Discharge" listed in these Technical Specifications. In hot weather or under conditions contributing to quick stiffening of

the concrete, or where the temperature of the concrete is 85°F or above, the times shall be reduced to one-half the time as specified. The ENGINEER may allow a longer time, providing the setting time of the concrete is increased a corresponding amount by the addition of an approved set-retarding mixture. Concrete shall be deposited as closely as possible to its final position in the forms so that it flows within the mass and consequent segregation is reduced to a minimum. Vibrators may be used to aid in the placement of the concrete provided they are used under experienced supervision, and the forms designed to withstand their action. The duration of vibration shall be limited to that necessary to produce satisfactory consolidation without causing objectionable segregation. Vibration shall not be applied directly to the reinforcement steel or the forms nor to concrete; which has hardened to the degree that it does not become plastic when vibrated.

When a vibrator is used, the CONTRACTOR shall also space the concrete along form surfaces a sufficient amount to prevent excessive size or numbers of air-void pockets in the concrete surface.

33.11.2. **Addition of Water at Jobsite:** When concrete arrives at the jobsite with a slump that is lower than allowed by design or specification and/or is of such consistency so as to adversely affect the placeability of the concrete, water can be added to the concrete to bring the slump up to acceptable or specified level. This can be done at the job site as long as the specified slump and/or water-cement ratio is not exceeded. Addition of water in excess of the design mixing water will affect concrete properties, such as reducing strength and making it more susceptible to cracking.

Before any water is added to the mixture a slump test must be performed. If it is decided to add water with the approval of the Engineer, the amount of water must be measured and recorded. The water amount shall not be more than 1 gallon of water at any one time. Once water is added the concrete shall be mixed by having the mixer drum do at least 30 revolutions at mixing speed. Once water is added another slump test should be performed.

Water should not be added if the maximum water-cement ratio is reached, the maximum slump is obtained or more than ¼ cubic yard of concrete has been discharged from the mixer.

33.11.3. **Lifts in Concrete:** The permissible depth of concrete placed in each lift shall be as shown on the Drawings or specified herein. All concrete shall be deposited in horizontal layers not exceeding twenty (20) inches in thickness, unless otherwise authorized or directed. The placement shall be carried on at such a rate that the formation of cold joints will be prevented. If a delay occurs in excess of a forty (40) minute interval between any two (2) consecutive batches or loads, or in case of any delay between placing batches that allows previously placed concrete to

take initial set, the CONTRACTOR shall discontinue the placing of concrete and make, at his own expense, a construction joint satisfactory to the ENGINEER before proceeding with the placing operations. He shall remove any portion of the previously placed concrete that is deemed necessary for the proper formation of the construction joint and no payment shall be made to the CONTRACTOR for the concrete removed.

The forty (40) minute limitation cited immediately above may be extended in those cases where an approved type retarder is added to the concrete mixture, to delay the set of the concrete. Use of a retarder in the mix shall be subject to approval of the ENGINEER. Hoppers, chutes, and pipes shall be used as necessary to prevent splashing of mortar on forms and reinforcing above the layer being placed.

33.11.4. Placing Temperature: Concrete shall be mixed and placed only when the atmospheric temperature is at least 40°F and rising, unless special permission to place is obtained from the ENGINEER. When the atmospheric temperature may be expected to drop below 40°F at the time concrete is delivered to the work site, during placement or any time during the curing period, the following provisions shall apply:

- (1) The temperature of the concrete, at the time of placing; shall not be less than 50°F nor more than 90°F. The temperature of neither aggregates nor mixing water shall be more than 100°F just prior to mixing with the cement. The ENGINEER shall approve all methods for heating the materials and protecting the concrete.
- (2) When the daily minimum temperature is less than 40°F, concrete structures shall be insulated or housed and heated after placement. The temperatures of the concrete and air adjacent to the concrete shall be maintained at not less than 50°F nor more than 90°F for the duration of the curing period.
- (3) Methods of insulation, housing and heating the structure shall conform to "Recommended Practices for Cold Weather Concreting", ACI Standard 306.
- (4) When dry heat is used to protect concrete, means of maintaining an ambient humidity of at least 40 percent shall be provided unless the concrete has been coated with curing compound as specified in subsection 19.5.3 or is covered tightly with an approved impervious material.
- (5) Salt, chemicals, or other materials shall not be mixed with the concrete for the purpose of preventing freezing.
- (6) Before any concrete is placed, all ice, snow, and frost shall be completely removed and the temperature of all surfaces to be in contact with the new concrete shall be raised to as close as may be practical to the temperature of the new

concrete that is to be placed thereon. No concrete shall be placed on a frozen sub grade or on one that contains frozen materials.

When climatic or other conditions are such that the temperature of the concrete may reasonably be expected to exceed 85°F at the time of delivery at the work site, during placement, or during the first 24 hours after placement, the following provisions shall apply:

- (1) The CONTRACTOR shall maintain the temperature of the concrete below 85°F during mixing, conveying, and placing. Methods used shall conform to "Recommended Practice for Hot Weather Concreting", ACI Standard 305.
- (2) The concrete shall be placed in the work immediately after mixing. Truck mixing shall be delayed until only time enough remains to accomplish it before the concrete is placed.
- (3) Exposed concrete surfaces which tend to dry or set too rapidly shall be continuously moistened by means of fog sprays or otherwise protected from drying during the time between placement and finishing, and after finishing.
- (4) Finishing of slabs and other exposed surfaces shall be started as soon as the condition of the concrete allows and shall be completed without delay.
- (5) Concrete surfaces exposed to the air shall be covered as soon as the concrete has hardened sufficiently and shall be kept continuously wet for at least the first 24 hours of the curing period, and for the entire curing period unless curing compound is applied as specified in accordance with these Technical Specifications.
- (6) Formed surfaces shall be kept completely and continuously wet for the duration of curing period (prior to, during, and after form removal) or until curing compound is applied as specified in accordance with these Technical specifications.
- (7) If moist curing is discontinued before the end of the curing period, white-pigmented curing compound shall be applied immediately.
- (8) Cover reinforcing steel with water soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
- (9) Wet forms thoroughly before placing concrete.

Concrete placement shall not be permitted when, in the opinion of the ENGINEER, the sun, heat, wind, or humidity prevents proper placement and consolidation.

33.11.5. **Concrete on Rock Foundations:** Rock surfaces upon which concrete is to be placed shall be clean, free from oil, standing or running water, mud, objectionable coatings, debris, loose, semidetached, or unsound fragments. Faults or seams shall be cleaned to a depth satisfactory to the ENGINEER, and to firm rock on the sides. Immediately before concrete is placed, all such rock surfaces shall be cleaned thoroughly by use of high velocity air-water jets, wet sandblasting, or other means satisfactory to the ENGINEER. All rock surfaces shall be kept continuously wet for forty-eight (48) hours and all approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar of the same sand-cement ratio as used in the concrete; unless this criteria is waived by the ENGINEER.

33.11.6. **Concrete on Earth Foundations:** Unless otherwise authorized, all concrete shall be placed upon clean, damp surfaces free from frost, ice, or deleterious materials, and standing or running water. Concrete shall not be placed in mud, dried porous earth or upon fill that has not been subject to approved rolling or tamping until optimum compaction has been obtained. The CONTRACTOR shall take all measures to accomplish the results specified in this paragraph.

33.11.7. **Vertical Joint Spacing:** The layout of all monoliths shall be shown on the Drawings or as directed and approved by the ENGINEER before construction is started.

33.11.8. **Placing Concrete Through Reinforcement:** In dropping concrete through reinforcement, care shall be taken that no segregation of the coarse aggregate occurs.

33.11.9. **Concrete Pumps:** With the approval of the Engineer concrete pumps may be used provided the designated strength is obtained. Slump tests shall still be taken and noted. Before any pumps are to be used they shall request in writing that they be allowed to use pump(s) and state the mix and slump that the pump will be using and that they are responsible for obtaining the desired concrete strength.

33.12. **CONSTRUCTION JOINTS**

Construction joints shall be located as indicated on the Drawings, or as approved by the ENGINEER. **Where no joint spacing is indicated, joints shall be placed at a minimum of 10' and a maximum of 20'.** The surfaces of construction joints shall be clean when covered with fresh concrete. Cleaning shall consist of the removal of all laitance, loose or defective concrete and foreign material. Cleaning of the surface of construction joints shall be accomplished by the use of high velocity air-water jets, wet sandblasting, or other effective means satisfactory to the ENGINEER. Surfaces of construction joints that have been permitted to dry by reason of the succeeding lift or adjoining concrete not being placed within the specified post-curing period shall be

moistened and kept continuously moist for at least forty-eight (48) hours immediately prior to the placing of the succeeding lift of adjoining concrete. All pools of water shall be removed from the surface of construction joints before the new concrete is placed.

33.13. PATCHING CONCRETE

Any concrete which is not formed as shown on the Drawings, or for any reason is out of alignment or level, or shows a defective surface, or shows defects which reduce the structural adequacy of a member or members, shall be considered as not conforming to the intent of these Technical Specifications and shall be removed from the job by the CONTRACTOR at his expense, unless the ENGINEER grants permission to patch the defective area. Permission to patch any such surface shall not be considered a waiver of the ENGINEER'S right to require complete removal of the defective work if the patching does not, in his opinion, satisfactorily restore the quality and appearance of the surface, or if patching does not restore the structural adequacy of the member or members. Repair work shall be performed only when the ENGINEER is present. Repair of formed surfaces shall be started within 24 hours after removal of the forms. All new concrete shall be secured with keys, dovetails, or anchors.

After removing forms, inspect all concrete surfaces. Patch any pour joints, voids, honeycomb, stone pockets, or other defective areas permitted by the ENGINEER to be patched, and all tie holes (except where noted otherwise elsewhere). Where necessary, chop away defective areas to a depth of not less than one inch with the edges perpendicular to the surface.

Apply bonding agent to area to be patched with care to keep bonding agent off of areas to remain exposed. Apply bonding agent in accordance with manufacturer's printed instructions.

The patching mortar shall be made of the same material (and of approximately the same proportions) as used in the concrete for the same location except that the coarse aggregate shall be omitted for concealed locations. Patching mortar shall be of same composition as adjacent concrete in exposed-aggregate concrete. The mortar shall not be richer than one part cement and three parts sand. White Portland cement shall be substituted for a part of the gray Portland cement so as to match the color of the surrounding concrete. The proportion of white and gray cements shall be determined by making a trial patch. The amount of mixing water shall be as little as is consistent with the requirements of handling and placing. The mortar shall be retempered without the addition of water by allowing it to stand for a period of one hour, during which time it shall be mixed occasionally with a trowel to prevent setting.

Compact the mortar thoroughly into place, and screed off so as to leave the patch slightly higher than the surrounding surface. Leave patch undisturbed for a period of one to two hours to permit initial shrinkage before beginning final finishing. Finish patch

in such a manner as to match the adjoining surface. All patches shall be finished and cured in accordance with requirements for the surface in which patch occurs. Keep patch moist for not less than three days after installation.

For unexposed concrete the following applies:. Tie-holes left by withdrawal of rods, or the holes left by removal of ends of ties shall be filled solidly with mortar after first being wet thoroughly. For holes passing entirely through a wall, a plunger-type grout gun shall be used to force the mortar through the wall, starting at the back face. A piece of burlap or canvas shall be held over the hole on the outside; and when the hole is completely filled, the excess mortar shall be struck off with the cloth flush with the surface. Holes not passing entirely through the walls shall be filled with a small tool that will permit packing the hole solidly with mortar. Any excess mortar at the surface of the wall shall be struck off flush with a cloth.

33.14 **FINISHING**

33.14.1. **General:** In order that the rubbing required by these Technical Specifications shall be effective, non-supporting forms may be removed after 24 hours, provided the concrete is sufficiently strong not to be injured thereby. Initial rubbing required shall be completed within 48 hours after concrete placing. If possible, patching and rubbing shall be done at the same time. This requirement regarding form removal is secondary to heating requirements, and the specifications heretofore included regarding heating of concrete shall take precedence.

Joints and edges of unformed surfaces that will be exposed to view shall be chamfered or finished with molding tools. At tops of walls, horizontal offsets and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise shown.

33.14.2. **Type I Finish:** Type I finish is a standard rough form finish for formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise shown or specified. This is the concrete surface having a texture imparted by the form facing material used, with defective areas repaired and patched as specified, and fins and other projections exceeding one-quarter inch (1/4") in height rubbed down with wood blocks. **All Driveways shall be Type I Finish.**

33.14.3. **Type II Finish:** Type II finish is a standard smooth finish for formed concrete surfaces exposed-to-view or that are to be covered with a coating of material applied directly to the concrete. This is the as-cast concrete surface as obtained with

the form facing material, with defective areas repaired and patched as specified, and fins and other projections on the surface completely removed and smoothed. All surfaces that will show in the finished work shall be rubbed down with a coarse carborundum stone or covered with a masonry coating material approved by the ENGINEER. **All concrete drainage structures shall be Type II Finish.**

33.14.4. **Type III Finish:** Type III finish is a float finish to be used on all horizontal surfaces not subject to wear and those surfaces which do not receive Type II finish such as back walls and headwalls. The finish shall be accomplished by placing an excess of materials in the form and removing or striking of such excess with a wooden template, forcing coarse aggregate below the surface. After the concrete has been struck off as described, the surface shall be thoroughly worked and floated by hand with a wooden float leaving a fine grained, smooth-sanded surface. **All retaining walls shall be Type III Finish.**

33.15. **CURING AND PROTECTION**

33.15.1. **General:** Protect freshly placed concrete from premature drying and from excessive cold or hot temperatures, and maintain, without drying, at a relatively constant temperature for a period of time necessary for hydration of cement and proper hardening. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. If Weather permits, keep continuously moist for not less than 72 hours. Unhardened concrete shall be protected from heavy rains and flowing water. All concrete shall be adequately protected from damage. Begin final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 168 cumulative hours (not necessarily consecutive) during which concrete has been exposed to air temperatures above 50°F. Avoid rapid drying at end of final curing period. All hot weather concreting shall conform to requirements set forth in ACI 305, "Recommended Practice for Hot Weather Concreting".

33.15.2. **Moist Curing:** Concrete shall be moist cured by maintaining all surfaces continuously (not periodically) wet for the duration of the entire curing period. Water for curing shall be clean and free from any elements which will cause staining or discoloration of the concrete. Where wooden forms are used and left in place during curing, the wood shall be kept wet at all times.

33.15.3. **Membrane Curing:** At the option of the CONTRACTOR and when approved by the ENGINEER, the concrete may be cured with an approved curing compound of the surface membrane type in lieu of moist curing with water. The curing compound shall be applied to formed surfaces immediately after the forms have been removed and the surfaces cleaned of any loose sand, mortar, and debris. The surface to receive the compound shall be moistened thoroughly with water and the compound applied as soon as the moisture film has

disappeared, but when the surface is still damp. On unformed surfaces the compound shall be applied immediately after the surface loses its free water and has a dull appearance. The curing compound shall be applied in a two-coat continuous operation by approved spraying equipment and at a coverage of not more than two hundred (200) square feet per gallon for both coats. The second coat shall be applied to overlap the first coat in a direction at approximately right angles to the direction of the first application. Concrete surfaces, which are subjected to heavy rainfall within three (3) hours after the curing compound has been applied, shall be re-sprayed by the method and at the rate of coverage specified herein. All concrete surfaces on which curing compound has been applied shall be adequately protected for the duration of the entire curing period from any damage that would disrupt the continuity of the curing membrane. The curing compound shall conform to Type 2 or Type 3 of ASTM Designation C 309. All curing compound shall be delivered to the site of the work in the original sealed container bearing the name of the manufacturer, the brand name and the manufacturer's batch number. The compound shall be approved prior to use. The compound shall be stored so as to prevent damage to the containers, and water-emulsion types shall be protected from freezing.

33.15.4. **Moisture Cover Curing:** Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

33.15.5. **Curing Formed Surfaces:** Cure formed concrete surfaces and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by other applicable methods specified herein.

33.15.6. **Curing Unformed Surfaces:** Initially cure unformed surfaces, such as slabs and other flat surfaces, by moist curing; and final cure by applicable methods specified herein.

33.15.7. **Cold Weather:** The air and forms in contact with the concrete shall be maintained at temperatures above 40°F for at least five (5) days, and at a temperature above freezing for the remainder of the specified curing period. Concrete, permitted to be cured with curing compounds, shall be provided the same protection against freezing and low temperatures. No fire or excessive heat shall be permitted near or in direct contact with concrete at any time. All cold weather concreting shall conform to requirements set forth in ACI 306, "Recommended Practice for Cold Weather Concreting".

33.16. **FORMWORK**

33.16.1. **General:** Unless otherwise shown or specified, design, construct, erect, maintain and remove forms, and related structures

for cast in place concrete work in compliance with the American Concrete Institute Standard ACI 347, "Recommended Practice for Concrete Formwork".

33.16.2. **Forms for Exposed Finish Concrete:** Unless otherwise shown or specified, construct all formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other acceptable panel-type materials, to provide continuous, straight, smooth exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection. Use plywood complying with the U.S. Product Standard PS-1 "B-B Concrete Form) Plywood" Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible trademark of an approved inspection agency, unless otherwise acceptable to ENGINEER.

33.16.3. **Forms for Unexposed Finish Concrete:** Form concrete surfaces, which will be unexposed in finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two edges and one side for tight fit. Use either 6-inch or 8-inch wide lumber, nominal 1-inch thickness, or as specified for exposed concrete, at CONTRACTOR'S option.

33.16.4. **Earth Forms for Trench Excavation:** Where trench excavation is used and walls of excavation are neatly cut in good soil, side forms may be omitted for footings and for some select retaining walls as permitted by the ENGINEER.

33.16.5. **Formwork Accessories:** Form ties where concrete is unexposed shall be standard crimped snapties. Form ties where concrete is exposed, as finish shall be a snap-in form tie with plastic cones. Form ties shall be manufactured by Meadow Steel Products Company, Dayton Sure-Grip and Shore Company, Universal Form Clamp Company, or equivalent. Form releasing agent shall be non-staining "Form Oil" as manufactured by Texaco, Sinclair, Georgia Carolina Company, or equivalent.

33.16.6. **Form Construction:** Forms shall be constructed in accordance with ACI 347 and shall conform to shape, lines, and dimensions of members indicated, and shall be substantial and sufficiently tight to prevent leakage of mortar. They shall not deflect under dead load weight of concrete as a liquid or of construction load. Forms shall be braced or tied together so as to maintain position and shape. Construct forms so that they can be removed readily without hammering or prying against concrete. Forms for exposed concrete shall be carefully made and accurately placed to obtain correct shape and lines.

The CONTRACTOR shall be fully responsible for adequacy of formwork in its entirety. Forms shall support loads they will be required to sustain and shall maintain their dimensional and surface

correctness to produce members required by the Drawing.

Trap door shall be built in the bottom of wall forms for access to interior of forms to permit inspection and cleaning.

The CONTRACTOR shall build bulkheads with keys in walls, footings, and slabs where it is necessary to stop placing of concrete.

33.16.7. **Reused Forms:** Forms which are reused shall be thoroughly cleaned of dirt, debris, concrete, and foreign matter. Forms shall not be reused if they have developed defects which would affect their tightness and strength. Marred surfaces in contact with concrete shall be repaired before reuse.

33.16.8. **Plywood Forms:** Plywood forms shall be of material as specified in these Technical Specifications. Joints shall be butted tight on solid bearings. Arrangement of panels shall be orderly and symmetrical, and use of small pieces shall be avoided. Forms shall be chamfered for external corners of concrete, which will be exposed, in finished work.

33.16.9. **Removal of Forms:** Formwork not supporting weight of concrete, such as walls and similar parts of the work may be **removed 24 hours** after placing concrete, provided concrete is sufficiently hard not to be damaged by form removal operations, and provided curing and protection operations are maintained. The CONTRACTOR shall assume full responsibility for removal of formwork and forms.

33.16.10. **Inspection and Approval of Formwork:** Forms, form joints, and reinforcing steel placement shall be checked by the ENGINEER before closing the forms. Concrete shall not be placed in any form until the placing of steel and erection of formwork have been completed and approved by the ENGINEER. Immediately after completion of pouring, tops of all forms shall be adjusted to line and approved by the ENGINEER as to conformity within the tolerances specified herein.

33.17. **EMBEDDED ITEMS**

33.17.1. **General:** Before placing concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the Drawings or required by the ENGINEER. All embedded items shall be thoroughly clean and free of oil and other foreign matter such as loose coatings of rust, paint, and scale. The embedding of wood or other perishable materials in concrete shall be prohibited unless specifically directed or authorized by the ENGINEER. Any air or water lines or the materials embedded in structures, as construction expedients authorized by the ENGINEER, shall conform to the above requirements and, upon completion of their use, shall be backfilled with concrete or grout as directed by the ENGINEER.

33.17.2. **Pipe Embedded in Concrete:** Where pipe is partially or wholly encased in concrete, care shall be taken that the pipe is firmly and securely held in place so that the alignment and grade of the pipe is not disturbed while the concrete is placed around the pipe. The trench excavated for the pipe shall be thoroughly cleaned and free from any foreign matter and completely filled with concrete to a depth one foot over the pipe.

33.18. **PRECAST AND/OR PRESTRESSED CONCRETE STRUCTURES**

All concrete structures (i.e. headwalls, culverts, lagging, etc.) that are precast and/or prestressed before being delivered shall meet the requirements of this Technical Specification as well as the Technical Specification covered in the Kentucky Transportation Cabinet's "Standard Specifications for Road and Bridge Construction", current edition. All structures shall carry a certification from the manufacturer that they will meet these specifications.

33.19. **BACKFILL:**

Backfill consisting of either earthen material or rock shall not be placed until after the 7-day compressive strength test has been completed and reviewed by the Engineer. The Engineer shall approve when placement of the backfill can begin.

SECTION XXXIV

TECHNICAL SPECIFICATIONS

ROCKFALL NETTING

34.1 **SCOPE**

This shall include all highwall preparation efforts and securely installing rockfall netting on all designated areas as depicted in the drawings and as directed by the ENGINEER. In addition, it shall include installing anchor bars with grout to fasten the rockfall netting to highwall as directed by the ENGINEER. It shall be flexible zinc coated rockfall netting of the type and sizes specified below. It is made of wire mesh of the type and size and selvages as specified in the following paragraphs.

34.2 **MATERIAL**

34.2.1 **Wire:** All wire used in the fabrication of the rockfall netting and in the wiring operations during construction for the Zinc Coating and Tensile Strength shall be in accordance with the requirements of ASTM A 641-92, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire, for galvanized wire, class 3, soft temper, as measured before fabrication of the netting. The **nominal** diameter of the wire used in the fabrication of the netting shall be 0.120 inches. (0.120 inches.....mesh.....0.85 ozs./sq.ft.) Standard Zinc-Coated rockfall netting shall have the following dimensions:

Nominal Length = 150 feet

Nominal Width = 12 feet

Other dimensions may be used as approved by the ENGINEER.

34.2.2 **Zinc:** All wire used in the fabrication of the rockfall netting and in the wiring operations during construction shall be coated to ASTM A 641-92 for Zinc coated (galvanized) carbon steel wire. The minimum weight of the zinc coating shall be according to the figures shown in the table below when tested in accordance with ASTM A 90-93.

The adhesion of the zinc coating to the wire should be such that, when wrapped around a mandrel in accordance with ASTM A 641-92, the zinc coating will not crack or flake to such an extent that any zinc can be removed by rubbing with the bare fingers.

34.2.3 **Lacing Wire:** Sufficient lacing and connecting wire shall be supplied with the rockfall netting for all wiring operations carried out in the construction of the meshwork. The lacing wire procedure consists of cutting a length of lacing wire approximately 1-1/2 times the distance to be laced (not to exceed 5 feet). Securing one of the wire at the corner by looping and twisting, alternately lacing with single and double loops every other mesh opening at intervals of not more than six (6) inches (150 mm) and securing the other end of the wire to selvages by looping and

twisting. The **nominal** diameter of lacing wire shall be 0.0866 inches. (0.0866 incheslacing wire ... 0.70 ozs./sq.ft.)

34.2.4 **Fasteners:** Rings can be used in lieu of lacing wire for assembly and installation operations of the mesh. Rings shall be supplied with the same Zinc Coating as the mesh and the wire diameter of the rings shall be the same as the GABIONS (Reference No. 11G40) or other manufacturer producing similar rings, shall be coated in accordance with ASTM A 641-92. Coating weight per ASTM A 90-93, also ASTM A 764-93, Class II, Type III. Tensile strength to be determined as per ASTM E 8/MTP 2004. Spacing of the fasteners must not exceed six (6) inches.

34.2.5 **Selvages:** All edges of the standard rockfall netting including end-panels and the diaphragms, if any, shall be mechanically selvaged in such a way as to prevent unraveling of the mesh and to develop the full strength of the mesh. The wire used for the selvedge shall have a diameter greater than that of the wire used to form the mesh, namely:

For the 8 x 10 type mesh made of wire having a **nominal** diameter of 0.120 inches the selvedge shall be of wire having a **nominal** diameter of 0.1535 inches or greater. (0.1535 inches dia. selvedge 0.90 ozs./sq.ft. coating weight)

34.2.6 **Anchor bars:** Unless shown otherwise on the plans, anchor bars shall consist of No. 5 reinforcement bar bent into an L-shape. The short leg of the L-shaped bar shall be approximately 6 inches (152.4mm) long and the long leg 2 feet (.61 meters) long.

34.3. **FABRICATION**

The mesh shall be hexagonal woven mesh with the joints formed by twisting each pair of wires through three half turns. Because of their appearance, the joints are often termed triple twisted. The size of the mesh conforms to the specifications issued by the plant and shall be of 8 x 10 type mesh. Nominal mesh size is 3-1/4 x 4-1/2 inches.

According to engineering requirements the rockfall netting incorporate diaphragms to form cells having a length not greater than one and half the width of the mesh.

34.4. **INSTALLATION**

34.4.1 **Highwall Preparation:** The highwall shall be thoroughly cleaned and secured to remove all loose rock, soil and debris prior to the installation of rockfall netting. This shall be achieved by pressure washing or other methods approved by the ENGINEER. A Hoe Ram shall be utilized as well to remove the existing overhang and other protruding/large unstable rock as directed by the ENGINEER. The hoe ram shall have a minimum weight of 2000 lbs. and a minimum delivery capability of 300 rams per minute.

The CONTRACTOR shall exercise extreme caution with working around highwall area as loose rock and debris exists within this area. The CONTRACTOR shall prevent workers from entering areas where potentially loose rock and other debris may fall thereby eliminating potential hazards to workers. The CONTRACTOR shall take measures to protect the existing structure during this and all phases of work.

34.4.2 **Rockfall Netting Installation:** Once highwall has thoroughly cleaned and secured, anchor bars (#5 Rebar) shall be set into predrilled holes 24" (depth min.) within the highwall and grouted in place. The rockfall netting shall be secured to the anchor bars using lacing wire or other techniques approved by the ENGINEER. The ENGINEER reserves the right to request the CONTRACTOR to place the anchor bars more frequently than depicted in the drawings if in the opinion of the ENGINEER it is warranted for long term structural integrity. Rockfall netting shall be shape to contour the highwall (2-inch max. off highwall face) with weep holes installed (8" PVC Pipe) sloped to drain outward. No shotcrete shall be applied to the rockfall netting until approval is given from the ENGINEER—see shotcrete technical specification.

34.4.3 **Anchor bars:** Unless otherwise shown on the plans, anchor bars shall be placed at approximately 8-foot (3.1 meters) centers maximum with the beginning row near the top of highwall, both horizontal and vertical, in 1 ¼-inch (31.8mm) holes drilled into the rock/soil face 24 inches deep. The drilled hole shall be blown clear prior to installation of the anchor bar. The drilled hole shall be completely filled with neat cement grout using a grout tube extending to the bottom of the hole. The anchor bar shall be pushed into the grout-filled hole and centered such that the short leg of the L-shaped bar points upward and is located about 1½ inches (38mm) from the rock/soil surface. Other locations and more frequent spacing may be required when the opinion of the ENGINEER, significant attachment is being achieved.

34.5. **TOLERANCES**

Tolerances on the diameter of all wire in the above clauses shall be permitted in accordance with ASTM A 641-92 Table 3. Tolerances of (+/-) 5% on the width, and length of the rockfall netting shall be permitted.

All dimensions are subject to confirmation as manufacturing requirements may dictate that the **nominal** sizes shall be varied from those given herein and tolerance shall apply to these adjusted dimensions.

Test shall be made on the wire before fabrication of the rockfall netting on a sample twelve inches long. Elongation shall not be less than 12%, in accordance with the requirements of ASTM A 370-92, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.

SECTION XXXV

TECHNICAL SPECIFICATIONS

STRUCTURE REMOVAL/REPLACEMENT

35.1. SCOPE

The work shall consist of the required removal and "in - kind" replacement of existing structural features to facilitate normal construction activities as determined by the ENGINEER. Work primarily includes removal and replacement of wooden decks, carports, sheds, dog pens, property fences and replacement fences as depicted / described on the drawings or as directed by the ENGINEER.

35.2. CONSTRUCTION METHODS

Prior to work concerning any designated structure, the CONTRACTOR and ENGINEER shall document the size, layout, and condition of all structural features subject for temporary removal. **Property fences that are approved for removal / replacement efforts shall be surveyed, and then resurveyed so that the replacement fence can be constructed in the exact location as was located prior to initial construction activities. See Fence Section of these technical Specifications for further information regarding property fences.** During removal efforts, the CONTRACTOR shall make a reasonable effort to preserve reusable material(s) for subsequent replacement work. Replacement work shall be completed using original or like materials and reconstructing as existing prior to removal (size, shape, and design); HOWEVER, the ENGINEER reserves the right to make modifications from the original condition to ensure long term structural integrity of any replacement feature. All such removal and replacement activities are to be performed with the prior approval of the ENGINEER.

35.3 NON-QUALIFYING FEATURES

Structural features such as stick built homes, garages (on foundations), mobile homes, trailers, and other residential type structures shall NOT be considered for temporary relocation under any circumstance. Other structural features, which may otherwise qualify for removal/replacement, will not be subject under this specification IF in the opinion of the ENGINEER movement of item(s) is merely for convenience. No structural elements outside of the designated construction limits shall be subject for removal and replacement. No replacement efforts, in part or in whole, shall be performed on any structural element damaged due to CONTRACTOR carelessness.

SECTION XXXVI

TECHNICAL SPECIFICATIONS

CHANNEL RESTORATION

36.1. SCOPE

This item consists of constructing and/or reconstructing channels at designated locations. Work shall include construction of riffle structures, pools, bank stabilization utilizing boulders and cobbles excavated from the slide/borrow areas. Work also includes planting trees and shoots at designated locations.

36.2. NATIVE STONE

Native stone shall consist of boulders, cobbles, field stones, and rock rubble excavated from borrow areas, refuse areas and occurring along the existing channel. Material shall be segregated by use of screens, grids, or mesh openings such that no more than 20% of the material shall pass through screens with 5 inch x 5 inch openings. Boulders shall be no larger than one cubic yard. Highly erodible sandstone or shale shall not be utilized nor shall acid bearing sandstones or shale.

36.3. PLANTINGS

Plantings shall be live cuttings from native willows and river birches. Plantings shall be cut and transplanted during the dormant season. Cuttings must be maintained in a cool, moist environment throughout the transplanting processes. Cuttings shall be 1 inch to 3 inches in diameter and approximately 3 to 4 feet in length. Plantings shall be embedded to appropriate depths which will ensure the success of the transplant. Plantings shall be watered throughout the contract period.

36.4. CONSTRUCTION

The CONTRACTOR shall be required to construct riffle structures, rock bar deflectors, and bank stabilization at designated locations. Generally, riffle structures shall be constructed for the entire width of the channel and shall be approximately 5 to 10 linear feet as measured along the center line of the stream. Rocks shall be mounded to approximate one foot depth above the base flow line. At some points trenches may be required to ensure the stability at the riffle structure. Deflectors shall be constructed from alternating sides and shall be approximately ¼ of the channel width and 3 feet above the normal flow line. Bank stabilization shall be applied at the outsides of meanders where erosion is likely to jeopardize the bank integrity. Plantings shall be spaced but staggered on three foot centers beginning above the normal flow line and extending to the top of bank or as directed by the ENGINEER.

SECTION XXXVII

TECHNICAL SPECIFICATION

SURCHARGE - BURNING REFUSE

37.1 **SCOPE**

This work shall consist of furnishing all equipment and labor necessary to excavate and extinguish burning refuse in a safe manor by methods described herein. This shall include providing methane/carbon monoxide detectors and respirators as well as fire retardant clothing for workers on site.

37.2 **MATERIALS**

All materials extinguished shall be unclassified. It is anticipated that the majority of material in the refuse / burning refuse area will be burning. The burning material may be in large pocket masses and/or veins of burning refuse which may extend into otherwise non-burning areas. Also large unstable voids may exist within this area which may have low bearing capacity. During the extinguishing process, open flames and smoke/dust/gases should be expected to occur.

37.3. **Extinguishing Methods**

The primary extinguishing method shall consist of spreading the burning refuse material out and "mixing" with soil material (cover material) from the borrow areas.

An alternate method using a wetting agent solution and/or water along with "mixing" shall be used if in the opinion of the ENGINEER "mixing" alone is not producing adequate results. If directed, the CONTRACTOR shall provide and maintain a minimum of 10,000 gallons of water and/or wetting agent solution on site until the burning refuse area is completely extinguished. Generally, wetting agent solution shall consist of 10 parts water to 1 part wetting agent concentrate (Cold Fire or equivalent) when directed and/or approved by the ENGINEER (*other solution percentages may be used as defined in the plans or as directed by the ENGINEER*). The solution shall be pre-mixed in tank(s); induction method of will not be acceptable. A delivery system capable of an application pressure of 100 pounds per square inch minimum (at nozzle) and a minimum flow rate of 250 gallons per minute shall required to deliver water/wetting agent.

Notwithstanding the method or methods utilized to extinguish the burning refuse, the material will be considered extinguished when it is reduced to a temperature of **100 degrees Fahrenheit or less. Any material greater than 100 degrees Fahrenheit is considered burning.** No material shall be placed in fill areas with a temperature higher than **100 degrees Fahrenheit** and until approval

from the ENGINEER has been given. The ENGINEER will take temperature reading on a regular basis however it is the responsibility of the CONTRACTOR to ensure no burning material is being placed in fill areas. The ENGINEER reserves the right to spot check any composite material placed in the fill areas to ensure no re-ignition has taken place; this may include requiring the CONTRACTOR to excavate areas for examination and temperature readings. If re-ignition occurs, the CONTRACTOR shall be required to extinguish it as soon as practical.

37.4. **SAFETY**

Due to the nature of refuse fires, safety is a primary concern and the CONTRACTOR is advised to use extreme caution when working in the burning refuse area. Gases such as methane, carbon monoxide, hydrogen sulfide and hydrogen may be emitted from the burning refuse and should be monitored as well as the possibility of explosions due to gas, steam and dust. The CONTRACTOR is also advised that voids may exist in the burning refuse area and should proceed with caution due to potentially low bearing capacity. Limiting the rate of extinguishing work and employing proper methods can minimize these risks. Proper safety equipment such as methane/carbon monoxide detectors as well as fire retardant clothing and respirators for workers shall be required. All OSHA regulations shall be followed.

At the end of the workday/workweek, the CONTRACTOR shall make every effort to minimize the risk of open flames and/or heavy smoke/dust/gases occurring during non-working hours. The CONTRACTOR shall be prepared to return to the site during non-working hours if such safety issues arise in the opinion of the ENGINEER. At no time shall the CONTRACTOR leave the work area with open flames and/or heavy smoke/dust/gases occurring.

SECTION XXXVIII

TECHNICAL SPECIFICATIONS

HAZARDOUS MATERIALS

38.1. **SCOPE**

The work shall consist of the proper disposal and documentation of all hazardous material remains located within the construction limits.

38.2. **MATERIALS**

31.2.1. **Hazardous Material Disposal:** Hazardous Material includes oil, fuel, batteries, lubricants, and chemical treatment (previously used for water treatment) all located within the construction limits.

38.3. **GENERAL**

Generally the work shall consist of the disposal of all hazardous material from the project area and its transportation to, and appropriate placement, in a permitted disposal facility. All hazardous materials located within the construction limits shall be marked or flagged by the ENGINEER. It is recommended that the contractor walk the sites and determine the risk. Those materials, which have a salvage value, may be disposed of in a manner as approved by the ENGINEER. The remains shall be transported in a safe manner, being covered or otherwise secured as necessary to prevent loss in transit.

It is the CONTRACTOR'S responsibility to determine the amount of effort required to complete this bid item. This includes any permits and safety measures that are necessary during all phases of this work.

SECTION XXXIX

TECHNICAL SPECIFICATIONS

DEMOLITION

39.1. **SCOPE**

This work consists of furnishing all labor, equipment and materials necessary for the demolition, removal and disposal of the structure(s) and/or abandoned equipment, as directed by the ENGINEER.

39.2. **CONSTRUCTION METHOD**

Before beginning any demolition or removal work, the CONTRACTOR shall carefully survey the existing structure(s) to determine the extent of the work. The CONTRACTOR shall provide for safe conduct of the work, removal and disposition of materials, and protection of property, which is to remain undisturbed. The CONTRACTOR shall construct and maintain shoring, bracing, and supports as required. The CONTRACTOR shall insure that structural elements are not overloaded, and shall be responsible for increasing structural supports by adding new supports as may be required as a result of any cutting or removal of other elements.

The CONTRACTOR shall take all necessary precautions to insure against damage to adjoining structure(s), which are to remain in place.

Foundations of demolished structure(s) shall be removed to a minimum of two (2) feet below the finished ground lines.

All rights to property and existing materials within the project area will remain the property of the owner. Salvageable material rejected by the owner shall become the responsibility of the CONTRACTOR to dispose of in a proper manner subject to the approval of the ENGINEER.

All non-salvageable or rejected structural elements, abandoned equipment and debris are to be transported to nearby project areas already requiring earthwork and buried as directed by the ENGINEER. Disturbances associated with demolition activities are to be graded and otherwise cleaned-up to the satisfaction of the ENGINEER, and then revegetated in accordance with these Technical Specifications.

SECTION XL

TECHNICAL SPECIFICATIONS

EQUIPMENT

40.1. SCOPE

This specification covers the supplying of the equipment, which is to be compensated for on an hourly basis, necessary to complete the project as it is described in these Technical Specifications and on the accompanying Drawings.

40.2. EQUIPMENT REQUIREMENTS

The following specifications will be applicable to any equipment required on this contract. The equipment will be operated at the capacity to produce the required horsepower and will be shifted at the resident inspector request.

40.2.1. Crawler Tractors: On any sites requiring more than 150 hours, the CONTRACTOR will be responsible for supplying two (2) tractors.

- A.
 - 1. Minimum Flywheel Horsepower: 500 h.p.
 - 2. Minimum Weight (including Blade): 140,000 lbs.
 - 3. Excellent working condition as certifiable by a Cabinet appointed mechanic.
 - 4. Equipped with Hydraulic Tilt Blade, Torque Convertor, Power Shift and Working Hourmeter
(Example Caterpillar D10)

- B.
 - 1. Minimum Flywheel Horsepower: 370 h.p.
 - 2. Minimum Weight (including Blade): 100,000 lbs.
 - 3. Excellent working condition as certifiable by a Cabinet appointed mechanic.
 - 4. Equipped with Hydraulic Tilt Blade, Torque Convertor, Power Shift and Working Hourmeter
(Example Caterpillar D9)

- C.
 - 1. Minimum Flywheel Horsepower: 270 h.p.
 - 2. Minimum Weight (including Blade): 80,000 lbs.
 - 3. Excellent working condition as certifiable by a Cabinet appointed mechanic.
 - 4. Equipped with Hydraulic Tilt Blade, Torque Convertor, Power Shift and Working Hourmeter
(Example Caterpillar D8)

- D. 1. Minimum Flywheel Horsepower: 200 h.p.
 2. Minimum Weight (including Blade): 51,100 lbs.
 3. Excellent working condition as certifiable by a Cabinet
 appointed mechanic.
 4. Equipped with Hydraulic Tilt Blade, Torque Convertor,
 Power Shift and Working Hourmeter
 (Example Caterpillar D7)
- E. 1. Minimum Flywheel Horsepower: 140 h.p.
 2. Minimum Weight (Including Blade): 30,600 lbs.
 3. Excellent working condition as certifiable by a Cabinet
 appointed mechanic.
 4. Equipped with Hydraulic Tilt Blade, Torque Convertor,
 Power Shift and Working Hourmeter
 (Example Caterpillar D6)
- F. 1. Minimum Flywheel Horsepower: 120 h.p.
 2. Minimum Weight (Including Blade): 28,000 lbs.
 3. Excellent working condition as certifiable by a Cabinet
 appointed mechanic.
 4. Equipped with Hydraulic Tilt Blade, Torque Convertor,
 Power Shift and Working Hourmeter
 (Example Caterpillar D6)
- G. 1. Minimum Flywheel Horsepower: 100 h.p.
 2. Minimum Weight (Including Blade): 15,000 lbs.
 3. Excellent working condition as certifiable by a Cabinet
 appointed mechanic.
 4. Equipped with Hydraulic Tilt Blade, Torque Convertor,
 Power Shift and Working Hourmeter
 (Example Caterpillar D5)
- H. 1. Minimum Flywheel Horsepower: 50 h.p.
 2. Minimum Weight (Including Blade): 15,000 lbs.
 3. Excellent working condition as certifiable by a Cabinet
 appointed mechanic.
 4. Equipped with Hydraulic Tilt Blade, Torque Convertor,
 Power Shift and Working Hourmeter
 (Example Caterpillar D4 & D3)

40.2.2. **Backhoe:**

Backhoe (Rubber Tired):

1. Minimum Bucket Capacity: 0.2 cu. yd. (heaped)
2. Minimum Digging Depth: 15 ft.
3. Minimum Reach: 17 ft.
4. Excellent working condition as certifiable by a Cabinet
 appointed mechanic.

Crawler Mounted Backhoe (Pull Shovel):

1. Minimum Horsepower: 130 h.p.
2. Minimum Bucket Capacity: 1.25 cu. yd. (heaped)
3. Minimum Digging Depth: 20 ft.
4. Minimum Reach: 30 ft.
5. Excellent working condition as certifiable by a Cabinet appointed mechanic.
6. Equipped with a Hydrostatic drive propel system and a working hourmeter.
7. Operating Weight: 38,000 lbs.

40.2.3. Hoe Ram (Excavator Attachment):

A. EXCAVATOR

1. Minimum Horsepower: 120 h.p.
2. Minimum Bucket Capacity: 1.5 cu. yd. (heaped)
3. Minimum Digging Depth: 20 ft.
4. Minimum Reach: 30 ft.
5. Operating Weight: 38,000 lbs.
6. Excellent working condition as certifiable by a Cabinet appointed mechanic.
7. Equipped with a Hydrostatic drive propel system and a working hourmeter.

B. HOE RAM

1. Minimum Weight: 2000 lbs.
2. Minimum Delivery Rate: 300 Rams per Minute.

40.2.4. Track Loader: A crawler mounted loader which meets the following requirements will be required on the project.

- A.
1. Flywheel Horsepower 110
 2. Minimum Bucket Capacity: 2 cu. yds.
 3. Minimum Operating Weight: 30,000 lbs.
 4. Equipped with Torque Convertor, Power Shift and Working Hourmeter.

40.2.5. Rock Trucks (Backdump):

- A.
1. Two (2) Axles
 2. 35 Ton Minimum Capacity (hauling)
 3. Diesel Engine
 4. Rear Dump
- B.
1. One (1) Axle
 2. 8 Ton Minimum Capacity (hauling)
 3. Rear Dump

40.3. EQUIPMENT CERTIFICATION

All equipment specified and furnished by the CONTRACTOR on this project must be certified as being in excellent working condition by the CONTRACTOR and approved by the Division of Abandoned Lands,

Environmental and Public Protection Cabinet. Upon the recommendation of the Resident Inspector, the Division of Abandoned Lands reserves the right to engage the services of a certified mechanic to inspect any equipment on site. Any equipment found not to be in compliance with these specifications will be repaired or replaced within a reasonable period of time. Inspection costs for any equipment determined to be substandard will be paid by the CONTRACTOR.

All equipment must meet the minimum requirement specified. The ENGINEER will not accept any substitutions for the equipment requirements as outlined in this specification. At the ENGINEER'S request, the CONTRACTOR may be required to supply the following:

- a. A factory certification of flywheel horsepower.
- b. A certified weight ticket of the tractor's weight, including blade. A representative of the Division of Abandoned Lands will be present when the tractor is weighed

40.4. **EQUIPMENT FAILURE AND REPLACEMENT**

In the event of equipment failure or breakdown, the CONTRACTOR will repair or provide replacement equipment within ten (10) days of the initial breakdown or failure. Replacement equipment furnished after the breakdown must meet the same specifications as listed in this specification and be approved by the Division of Abandoned Lands.

Failure to repair and/or replace broken down equipment within ten (10) days by the CONTRACTOR will be considered by the Division of Abandoned Lands and the Finance and Administration Cabinet as failure to perform. This declaration of failure to perform will result in an unsatisfactory Performance Evaluation and Receiving Report, Form B111-43. An unsatisfactory rating could have a bearing on future bidding privileges and/or approval of future bids.

40.5. **OPERATOR QUALIFICATIONS**

All equipment operators shall be competent and experienced with the type of equipment for which they are assigned.

Failure of any operator to display productivity commensurate to this requirement shall be grounds for the ENGINEER to require a replacement in that specific operating position.

40.6. **SAFETY STANDARDS**

All equipment used on this project must meet all of the appropriate OSHA safety requirements.

40.7. **PUMP**

40.7.1. **SCOPE**

The work will consist of utilizing a pump as set forth on the Bid Schedule.

40.7.2. **EQUIPMENT**

A pump with an intake as set forth on the Bid Schedule.

SECTION XLI

TECHNICAL SPECIFICATIONS

INDUSTRIAL MINING DEBRIS & DOMESTIC DEBRIS REMOVAL

41.1. SCOPE

The work shall consist of the demolition, removal, and proper disposal of all mining equipment, abandoned utilities, foundations, structural materials and domestic debris remains located within all construction limits.

41.2. MATERIALS

41.2.1. Domestic Debris: Domestic Debris includes discarded paper, plastic, rubber, metal (cans) and glass materials commonly associated with household garbage. This definition also includes used and discarded furniture, appliances, and loose passenger vehicle tires located within all construction limits.

41.2.2. Industrial Mining Debris: Industrial Mining Debris consists of any heavy equipment (bulldozers, trucks, and equipment), pipes, steel beams, large cables, tanks, trusses, metal roofing, and other items commonly associated with industrialize mining operations. This definition also includes abandoned utility poles, exposed concrete foundations and passenger vehicles located within all construction limits.

41.3. GENERAL

Generally the work shall consist of the demolition and removal of all mining equipment, abandoned utilities, foundations, metal roofs and domestic debris from the project area and its transportation to, and appropriate placement, in a permitted landfill. However, those materials, which have a salvage value, may be disposed of in a manner as approved by the ENGINEER. The CONTRACTOR shall advise the ENGINEER of the landfill to be used or salvage intent and shall obtain the ENGINEER'S approval prior to the hauling of all remains. The remains shall be transported in a safe manner, being covered or otherwise secured as necessary to prevent loss in transit. All remains shall be removed down to existing ground level.

It is the CONTRACTOR'S responsibility to determine the amount of effort required to complete this bid item. This includes any safety measures that are necessary during all phases of this work.